

· 技术创新 ·

非顶椎截骨矫正陈旧性脊柱结核角状后凸

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摘要: [目的] 介绍非顶椎截骨矫正陈旧性脊柱结核角状后凸的手术技术和初步临床效果。[方法] 对 14 例陈旧性脊柱结核性角状后凸的患者采用非顶椎截骨进行矫正手术治疗。后路充分暴露固定节段, 顶椎近侧放置 4 对椎弓钉, 远侧放置 3 对椎弓钉, 安装双侧棒临时固定。选择顶椎下方邻近解剖结构相对正常的椎体进行全椎体截骨, 交替调整双侧钉-棒, 配合体位调整, 逐渐矫正畸形。锁定钉-棒系统, 后侧植骨融合。[结果] 14 例患者均顺利完成了手术, 手术时间平均 (9.8 ± 2.3) h, 术中出血量平均 $(2\,150.0 \pm 937.9)$ ml。1 例患者术后出现自截骨平面以下的截瘫, 术后 1 年随访肛周及双下肢感觉及运动功能无明显恢复。所有患者均获随访 12 月以上, 与术前相比, 末次随访时 VAS 评分显著减少 $[(3.1 \pm 1.1), (1.5 \pm 0.5), P < 0.001]$; ODI 功能障碍指数无显著变化 $[(9.7 \pm 1.7), (9.9 \pm 4.6), P > 0.05]$ 。影像方面, 与术前相比, 术后 1 个月矢状面 Cobb 角 $[(151.1 \pm 28.7)^\circ, (19.7 \pm 5.2)^\circ, P < 0.001]$ 、矢状面偏移 $[(28.9 \pm 11.6)$ mm, (3.9 ± 2.8) mm, $P < 0.001]$ 、骶骨倾斜角 $[(14.1 \pm 5.3)^\circ, (22.3 \pm 5.6)^\circ, P < 0.001]$ 、骨盆倾斜角 $[(23.9 \pm 7.2)^\circ, (13.8 \pm 5.0)^\circ, P < 0.001]$ 均显著改善, 但骨盆指数无显著变化 $[(37.6 \pm 7.9)^\circ, (35.4 \pm 8.1)^\circ, P > 0.05]$ 。[结论] 非顶椎截骨矫正陈旧性脊柱结核角状后凸具有良好的后凸矫正效果。

关键词: 陈旧性脊柱结核, 角状后凸畸形, 非顶椎截骨

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Abstract: [Objective] To introduce the surgical technique and preliminary clinical results of non-apex vertebral osteotomy for the correction of angular kyphosis of old thoracolumbar tuberculosis. [Methods] A total of 14 patients received non-apex osteotomy and instrumented fusion for correction angular kyphosis of old thoracolumbar tuberculosis. After the involved segments were fully exposed through the posterior approach, the pedicle screws including 4 pairs on the cephalic side and 3 pairs on the caudal side were placed, and bilateral rods were installed for temporary fixation. The vertebrae with relatively normal anatomical structure below the apex vertebrae were selected for performing total vertebral osteotomy. The bilateral screw-rods were adjusted alternately with body position adjustment to gradually correct the deformity. Locking the screw-rod system, posterolateral bone grafting and the wound closed in layers were conducted. [Results] All the 14 patients successfully completed the operation, with operation time of (9.8 ± 2.3) hours and intraoperative blood loss of $(2\,150.0 \pm 937.9)$ ml. One patient developed paraplegia below the osteotomy plane after surgery, and no significant recovery of perianal and lower limb sensation and motor function was observed at 1 year postoperatively. All patients were followed up for more than 12 months. Compared with those preoperatively, the VAS score significantly decreased $[(3.1 \pm 1.1), (1.5 \pm 0.5), P < 0.001]$, while the ODI remained unchanged $[(9.7 \pm 1.7), (9.9 \pm 4.6), P > 0.05]$ at the latest follow-up. Radiographically, compared with those preoperatively, the sagittal Cobb angle $[(151.1 \pm 28.7)^\circ, (19.7 \pm 5.2)^\circ, P < 0.001]$, sagittal vertical axis $[(28.9 \pm 11.6)$ mm, (3.9 ± 2.8) mm, $P < 0.001]$, sacral slope $[(14.1 \pm 5.3)^\circ, (22.3 \pm 5.6)^\circ, P < 0.001]$, and pelvic tilt $[(23.9 \pm 7.2)^\circ, (13.8 \pm 5.0)^\circ, P < 0.001]$ significantly improved postoperatively, whereas without a significant change in pelvic incidence $[(37.6 \pm 7.9)^\circ, (35.4 \pm 8.1)^\circ, P > 0.05]$. [Conclusion] The non-apex vertebral osteotomy does achieve satisfactory correction for angular kyphosis of old thoracolumbar tuberculosis.

Key words: old thoracolumbar tuberculosis, angular kyphosis, non-apex osteotomy

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脊柱结核是最常见的骨关节结核^[1], 约占所有结核病的1%~3%, 脊柱结核常导致神经功能缺损和随后的功能恶化^[2], 特别是在脊柱结核后期会导致严重的角状后凸畸形^[3], 致残率高, 治疗难度大^[4, 5]。尽管近年来脊柱外科手术技术及手术器械得到了极大的提高及改善, 通常情况下矫形手术采用顶椎处截骨, 经椎弓根截骨、闭合-开放楔形截骨、全椎体截骨等术式取得了令人满意的效果^[6], 但顶椎处由于椎管狭窄、脊髓受压严重、局部血供差等特点使得矫形术后发生脊髓损伤的可能性更高^[7], 本研究在脊柱后凸顶椎下方相对正常的椎体处进行截骨矫正, 通过避开病灶区的手术操作以达到降低手术风险及难度的目的。本院2019年—2021年采用该方法治疗陈旧性脊柱结核角状后凸畸形患者14例, 现将手术技术及初步临床效果报告如下。

1 手术技术

1.1 术前准备

患者术前均表现明显脊柱后凸畸形(图1a), 入院后完善影像学检查, 包括全脊柱X线、全脊柱CT和全脊柱MRI(图1b)。加强全身营养支持, 纠正贫血, 定期复查炎症指标。嘱患者进行心肺功能锻炼, 完善相关检查后进行头盆环牵引手术, 持续牵引时间约3个月, 使得脊柱变得相对柔软。矫形手术前拆除头盆环并嘱患者绝对卧床, 矫形术中常规行神经电生理监测, 包括感觉诱发电位(sensory evoked potential, SEP)和运动诱发电位(motor evoked potential, MEP)。

1.2 麻醉与体位

采用全身麻醉, 矫形手术采用俯卧位, 双侧大腿下方放置气枕(图1c)。

1.3 手术方法

行后路纵行切口, 逐层切开皮肤及皮下组织, 充分显露固定节段。分别于顶椎近侧置入4对万向椎弓钉, 在顶椎远侧置入3对万向螺钉, 透视确认螺钉均位于椎弓根内。咬骨钳咬除顶椎及下方需要截骨椎体的棘突及椎板, 扩大椎管减压。使用脊柱5.5钉棒系统钛棒连接术者对侧的椎弓根螺钉进行临时固定(图1d), 避免截骨时椎体移位。选择顶椎下方解剖结构正常的椎体经椎弓根外侧行骨膜下剥离, 暴露该椎体及其上下的椎间盘及其下位椎体的一部分, 使用超声骨刀完整切除整个椎体及邻近的椎间盘、其下位椎体的一部分, 截骨满意后严格止血, 助手将气枕充气至

双侧大腿高于身体的体位, 安装术者侧椎弓根钛棒, 松开对侧临时固定钛棒, 部分矫形脊柱后凸畸形。预弯对侧钛棒并连接, 松开术者侧钛棒并加大其前凸, 脊柱后凸进一步矫正, 如此反复直到脊柱矫形满意(图1e)。安放3根横向连接杆, 将椎板后方凿成鱼鳞状后, 将患者自体的棘突及截骨椎体的骨松质放置于截骨上下椎体椎板的侧后方进行植骨融合, 截骨处于前方及侧方进行植骨融合(图1f), 手术全程神经电生理监测, 肌层下放置2枚引流管, 逐层缝合切口, 术中全程神经电生理监测。

1.4 术后处理

术后预防使用抗生素至术后48 h, 术后48 h内根据引流情况拔除引流管, 若合并脑脊液漏可延后至术后10 d拔管, 嘱患者于床上行双下肢及腰背部肌肉功能锻炼, 复查全脊柱X线及全脊柱CT(图1g), 术后2周佩戴支具离床活动(图1h)。

2 临床资料

2.1 一般资料

本组共14例患者, 均为陈旧性脊柱结核性后凸, 其中男4例, 女10例, 年龄(27.2 ± 13.2)岁, 所有患者既往均有明确的肺结核或脊柱窦道流脓病史, 现已治愈, 符合脊柱结核的影像学表现, 后凸Cobb角均 $>100^\circ$ 。排除其他疾病导致的单纯性脊柱后凸, 如退变性后凸、神经纤维瘤病导致的后凸等。本研究经医院伦理委员会批准, 所有患者或家属均知情同意。

2.2 初步结果

14例患者均顺利完成手术, 无死亡病例, 手术时间平均(9.8 ± 2.3) h, 术中出血量平均(2150.0 ± 937.9) ml, 其中1例于术后6个月出现内固定一侧纵杆的断裂, 并予以改换; 1例术后出现自截骨平面以下的截瘫, 术后1年随访肛周及双下肢感觉及运动功能无明显恢复; 1例出现切口感染, 经清创及负压吸引痊愈。

所有患者均获随访12个月以上, 与术前相比, 末次随访时VAS评分显著减少[(3.1 ± 1.1), (1.5 ± 0.5), $P < 0.001$]; ODI功能障碍指数无显著变化[(9.7 ± 1.7), (9.9 ± 4.6), $P > 0.05$]。

影像方面, 与术前相比, 术后1个月矢状面Cobb角[($151.1 \pm 28.7^\circ$), ($19.7 \pm 5.2^\circ$), $P < 0.001$]、矢状面偏移[(28.9 ± 11.6) mm, (3.9 ± 2.8) mm, $P < 0.001$]、骶骨倾斜角[($14.1 \pm 5.3^\circ$), ($22.3 \pm 5.6^\circ$), $P < 0.001$]、骨盆倾斜

角 $[(23.9 \pm 7.2)^\circ, (13.8 \pm 5.0)^\circ, P < 0.001]$ 均显著改善, 但 骨盆指数无显著变化 $[(37.6 \pm 7.9), (35.4 \pm 8.1), P > 0.05]$ 。

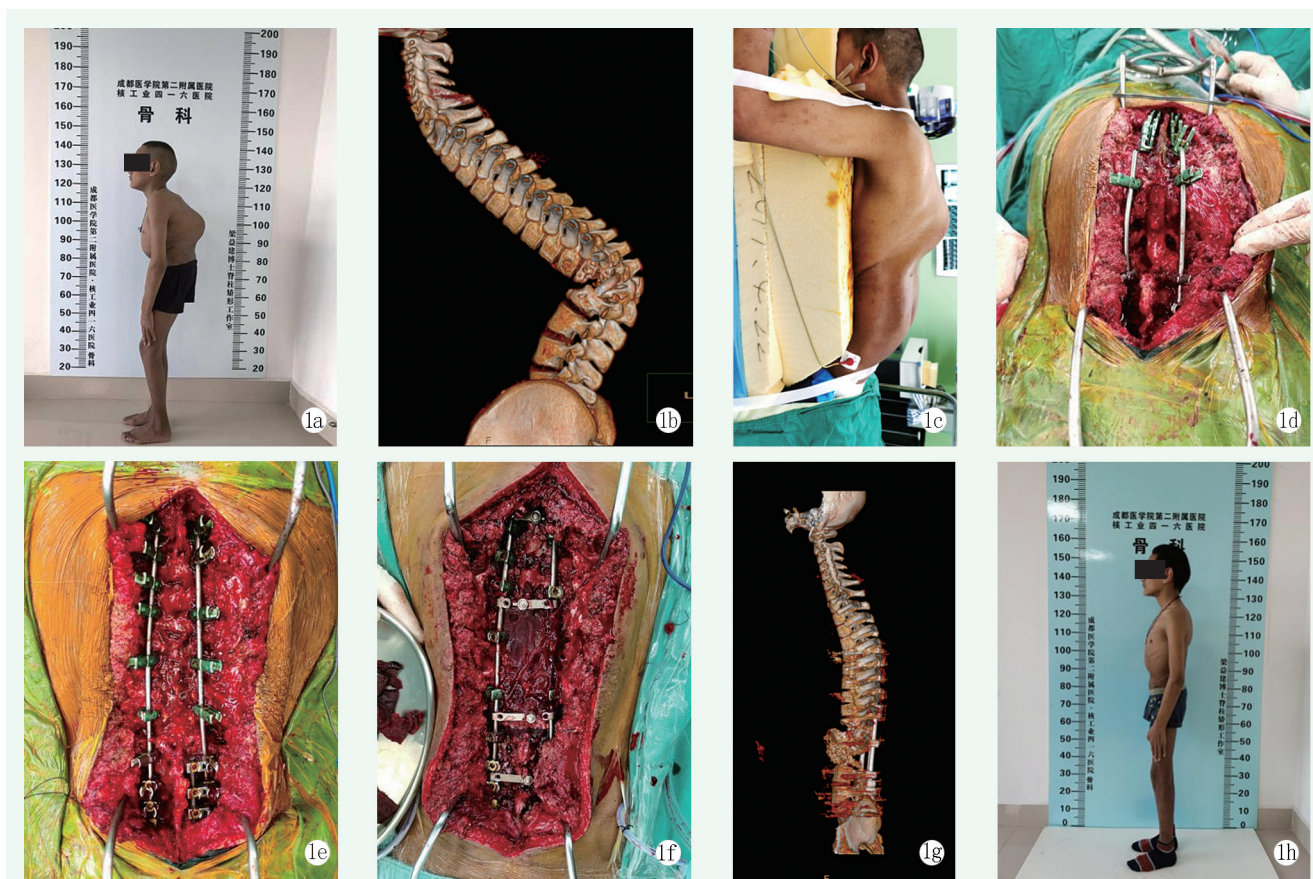


图 1 患者,男,13 岁,结核性脊柱后凸,I 期行头盆环牵引,II 期行经后路胸腰椎管减压+脊柱截骨矫正+脊柱钉棒系统内固定植骨融合术。1a: 术前患者大体照见巨大“驼峰”畸形;1b: 术前全脊柱三维 CT 重建显示脊柱明显后凸畸形,后凸 Cobb 角约 102° , $T_{12} \sim L_1$ 椎体融合局部后凸;1c: 术中采用俯卧位,双侧大腿下放置气枕;1d: 在后凸顶点近端双侧置入 4 对 (T_4 、 T_5 、 T_7 、 T_9) 椎弓根万向螺钉,远端双侧置入 3 对 (L_4 、 L_5 、 S_1) 椎弓根万向螺钉,完整切除 L_2 整个椎体及邻近的椎间盘、 L_3 部分椎体,临时棒固定;1e: 气枕充气至双侧大腿高于身体的体位,交替加大左右钛棒前凸,直至矫形满意;1f: 安放 3 根横 向连接杆,截骨上下椎体椎板的侧后方进行植骨融合,截骨处于前方及侧方进行植骨融合;1g: 术后复查三维 CT 显示矫形满 意,近端前移,远端后移,重塑椎管;1h: 术后大体照,外观基本恢复正常。

3 讨论

严重的后凸畸形有很高的神经损伤风险^[8],并且 顶椎处由于椎管狭窄^[9]、脊髓受压严重、局部血供差 等特点使得矫形术后发生脊髓损伤的可能性更高^[7], 一项大样本 26 207 例患者的研究,共发现并发症 9 138 例 (34.5%)^[10], Sangondimath 等^[11] 通过将融合 椎体一并切除并行后路椎弓根螺钉内固定、Zhang 等^[12] 将后凸处顶椎进行全椎体切除矫正脊柱后凸畸 形均完成了手术,但相对并发症较多,所以脊柱的角 状后凸畸形手术是一项巨大的挑战^[13, 14]。

脊柱结核良好的药物治疗是手术成功的基础^[15], 矫形手术的目的是恢复矢状面平衡,使得患 者重心重新恢复到矢状位骨盆中位线上^[16],将有助 于改善患者的日常护理,同时脊柱、骨盆参数也是手

术潜在的失败原因^[17, 18]。通过非顶椎处截骨治疗陈 旧性脊柱结核导致的角状后凸,可以很好地改善后凸 畸形及脊柱骨盆参数,进而减轻腰背部的疼痛。

头盆环牵引是一种缓慢而安全的畸形矫正方 法^[19]。对于严重后凸畸形的患者,避免了快速、一 期矫正带来的许多严重并发症^[20],在本研究中,I 期 采用头盆环牵引,使得原本僵硬的脊柱变得相对柔 软,II 期实施非顶椎截骨手术,避免了在病灶区脊髓 周围进行手术操作,减少了机械性刺激引起脊髓神经 受损的可能,明显降低了术后总并发症的发生,特别 是显著减少了神经损伤的发生率,通过对相对解剖正 常的椎体进行截骨,有效减少了术中出血量及手术时 间。

综上所述,非顶椎处截骨通过重塑椎管,调整了 脊髓的位置,治疗脊柱结核导致的严重角状后凸畸形 可能是一种更好的手术方式,可以明显降低手术相关

的并发症,缩短手术时间、减少术中的出血量,并且具有良好的后凸矫正效果,希望可以给临床上棘手的脊柱结核导致的严重角状后凸畸形矫正手术提供一定的参考。

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