

C₇T₁ 骨折脱位的临床特点及其 I 期前后路联合手术治疗

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【摘要】 目的: 总结 C₇T₁ 骨折脱位的临床特点, 探讨其 I 期前后路联合手术治疗方法。方法: 对 2005 年 1 月至 2010 年 3 月期间以 I 期前后路联合手术辅以非结构性植骨治疗的 8 例 C₇T₁ 骨折脱位患者病例资料进行回顾分析。患者均为男性, 平均年龄 45.0 岁 (32~68 岁), 其中 6 例患者入院时颈椎 X 线片无异常而由 CT 扫描明确诊断。骨折脱位按 AO 分型: B 型 4 例, C 型 4 例。合并单侧关节突交锁 2 例、双侧 2 例, 术前 MRI 显示椎间盘损伤者 6 例。结果: 患者手术时间 150~320 min, 平均 246.3 min; 出血量 150~600 ml, 平均 307.5 ml。术后出现声音嘶哑 1 例, 术后 6 个月时基本恢复; 无其他并发症发生。1 例 Frankel A 级患者死亡, 其余患者平均随访 38.6 个月 (12~63 个月)。骨折脱位均获完全复位, 术后 12 个月复查时骨折脱位均愈合, 无假关节形成。术后脊髓功能改善明显, 末次随访时 A 级中 1 例病故、1 例脊髓功能无变化, B 级 2 例恢复到 C 级 1 例、D 级 1 例, C 级 1 例恢复到 D 级, D 级 3 例均恢复到 E 级。结论: C₇T₁ 骨折脱位临床少见、容易漏诊, 有必要对颈椎 X 线片阴性而高度怀疑损伤者进行 CT 检查; 诊断明确后可尝试 I 期前后路联合手术辅以非结构性植骨治疗。

【关键词】 颈椎; 胸椎; 骨折; 脱位; 骨移植; 外科手术

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Clinical characteristics and stage I operation of anterior and posterior approaches for the treatment of cervicothoracic junction (C₇T₁) fracture-dislocation LIU Jin, LIU Hao, LI Tao, GONG Quan, and ZENG Jian-cheng. Department of Orthopaedics, West China Hospital, Sichuan University, Chengdu 610041, Sichuan, China

ABSTRACT **Objective:** To summarize the characteristics of cervicothoracic junction (C₇T₁) fracture-dislocation, and explore the surgical treatment of combined anterior-posterior procedure. **Methods:** From January 2005 to March 2010, 8 cases of cervicothoracic junction (C₇T₁) fracture-dislocation were treated by stage I operation through anterior and posterior approaches, supplemented by non-structural bone graft. All patients were male with a mean age of 45.0 years old ranging from 32 to 68 years. Six cases were diagnosed clearly by CT scan but with normal cervical spine X-ray film at admission. According to AO classification, 4 cases were of type B, 4 cases of type C, with unilateral locked articular process in 2 cases, bilateral in 2 cases. Preoperative MRI showed intervertebral disc injury in 6 cases. **Results:** The average operation time was 246.3 min ranging from 150 to 320 min. The blood loss was with an average of 307.5 ml (150 to 600 ml). One patient got hoarseness but recovered without special treatment 6 months later; No other complications happened. One patient of preoperative Frankel grade A died, the remaining patients were followed up from 12 to 63 months (38.6 months in average). These fracture-dislocations were completely reduction after operation, healed with bony union 12 months later, and no pseudoarthrosis. The function of the spinal cord improved obviously at the final follow-up, 1 patient of preoperative grade A had died, and the spinal cord function of the other one had no significant changes, the 2 cases of grade B recovered to C and D respectively, 1 case recovered from grade C to D, and 3 case recovered from D to E. **Conclusion:** Cervicothoracic junction (C₇T₁) fracture-dislocation is a rare clinical spine trauma, and missed easily. The CT is a necessary complement to these patients highly suspected C₇T₁ fracture-dislocation but with negative cervical spine X-ray film. The patients diagnosed clearly could receive stage I operation of anterior and posterior approaches, supplemented with non-structural bone graft.

KEYWORDS Cervical vertebrae; Thoracic vertebrae; Fractures; Dislocations; Bone transplantation; Surgical procedures, operative

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C₇T₁ 位于脊柱生理前凸向生理后凸的移行区域, 周围毗邻较多血管、神经等重要结构^[1], 解剖复杂, 临床上常称作颈胸段。该节段骨折脱位占颈椎损

伤的 2%~9%^[2-4],常伴有脊髓神经损伤^[4]。由于该节段独特的解剖特点,导致其手术显露及稳定性重建均较为困难,因此该节段损伤的手术治疗一直是脊柱外科医生关注的热点之一。笔者自 2005 年 1 月至 2010 年 3 月期间尝试以 I 期前后路联合手术辅以非结构性植骨治疗 C₇T₁ 骨折脱位患者 8 例,现报告如下。

1 资料与方法

1.1 一般资料

本组 8 例,均为男性;年龄 32~68 岁,平均 45.0 岁;车祸伤 2 例,高处坠落伤 5 例,重物砸伤 1 例。其中 6 例入院时颈椎正侧位 X 线片无异常而由 CT 扫描明确诊断。该组患者中,陈旧性骨折脱位 1 例,合并关节突交锁 4 例(单侧 2 例、双侧 2 例),合并 C₇ 双侧关节突骨折 3 例、单侧骨折 2 例、双侧椎板骨折 1 例,合并椎间盘损伤 6 例,合并上肢骨折 1 例,合并其他椎体及附件骨折 3 例。骨折脱位按 AO 分型 B 型 4 例,C 型 4 例。脊髓功能按 Frankel 分级 A 级 2 例,B 级 2 例,C 级 1 例,D 级 3 例。本组患者具体情况见表 1。

1.2 治疗方法

1.2.1 术前准备 患者入院后均常规进行颈椎正侧位 X 线片、颈椎 CT 三维重建及 MRI 等相关检查。1 例合并头皮撕脱伤患者行枕颌带牵引,其余患者均予中立位颅骨牵引,牵引重量 4~6 kg。牵引目的是避免加重脊髓神经损伤,缓解颈部肌肉痉挛及疼痛,不要求牵引复位。对于自受伤至入院不足 8 h 并伴有脊髓功能损害的 2 例患者,常规给予甲基强的松

龙冲击治疗。所有患者待生命体征平稳、一般状况改善后手术。患者手术距入院时间平均 13.8 d(5~28 d)、距受伤时间平均 18.8 d(8~45 d)。术前等待时间超过 13.8 d 的 3 例:其中 1 例因入院第 5 天哮喘发作,经呼吸内科系统治疗、哮喘控制后手术,术前等待 28 d;1 例因合并左肱骨骨折、肋骨骨折及肺挫伤经胸腔闭式引流等处理后于入院第 22 天手术;1 例患者因继发呼吸困难、肺部感染经气管切开、吸痰控制感染后于入院第 19 天行手术治疗。

1.2.2 手术步骤 手术均在气管插管全麻下进行,患者先取仰卧位,于患者右侧髂前上棘取适量松质骨并制成颗粒状碎骨块以备植骨之用。然后经右侧颈前 Smith-Robinson 入路,分离显露损伤节段椎体、椎间盘,常规切除损伤节段椎间盘、后纵韧带及碎骨片等,彻底减压至见硬脊膜膨起为止,并刮除上位椎体下方软骨终板、下位椎体上方软骨终板,保留骨性终板,以 Caspar 撑开器撑开恢复椎间隙高度,但不对后柱结构进行复位。椎间隙高度恢复满意后彻底冲洗、止血,于硬脊膜前方椎间隙内放入适量明胶海绵作衬垫,将备好的松质骨颗粒填入椎间隙内、压紧,缝合椎前筋膜,再次冲洗止血后留置橡胶引流管后关闭切口。在麻醉师协助下将患者调整至俯卧位并将头固定于 Mayfield 头架上,颈部略屈曲,使项部保持平直,消毒铺巾后取后正中入路暴露 C₆-T₂ 棘突,骨膜下剥离至侧块外侧,以神经剥离器探入交锁的关节突关节进行撬拨、同时向上提拉损伤节段棘突进行复位。关节突关节复位后,均以后路钉棒系统(M6,美国美敦力公司)固定。置钉方式上均采取 C₆

表 1 C₇T₁ 骨折脱位 8 例患者治疗前后的一般情况

Tab.1 General information of 8 patients with C₇T₁ fracture-dislocation before and after treatment

编号	性别	年龄(岁)	诊断	椎间盘损伤	手术时间(min)	出血量(ml)	治疗结果
1	男	37	C ₇ T ₁ 椎骨折脱位伴不全四肢瘫(AO:C1, Frankel D);C ₇ 双侧关节突骨折,C ₁ 左侧侧块骨折,C ₆ 棘突骨折,头皮裂伤	是	320	600	Frankel E
2	男	40	C ₇ T ₁ 椎骨折脱位伴不全四肢瘫、双侧关节突交锁(AO:B3, Frankel B);T _{2,3} 椎体撕脱骨折;左肱骨骨折;肋骨骨折、肺挫伤	是	300	350	Frankel C
3	男	51	C ₇ T ₁ 椎骨折脱位伴不全四肢瘫(AO:C2, Frankel B);C ₇ 左侧关节突交锁、右侧骨折;C ₅ 椎体撕脱骨折;L ₁ 椎陈旧性压缩骨折	是	300	200	Frankel D
4	男	32	C ₇ T ₁ 椎骨折脱位伴不全四肢瘫、双侧关节突骨折(AO:C3, Frankel D 级);头皮裂伤	是	250	400	Frankel E
5	男	39	C ₇ T ₁ 椎骨折脱位伴不全四肢瘫(AO, B3; Frankel D),C ₇ 双侧椎板骨折	否	150	200	Frankel E
6	男	68	C ₇ T ₁ 椎陈旧性骨折脱位伴四肢瘫(AO:B2, Frankel A),C ₇ 右侧关节突交锁、左侧骨折,头颈部皮肤裂伤	否	200	230	Frankel A
7	男	40	C ₇ T ₁ 椎骨折脱位双侧关节突交锁伴不全四肢瘫(AO:B2, Frankel C)、头皮裂伤	是	300	330	Frankel D
8	男	53	C ₇ T ₁ 椎骨折脱位双侧关节突骨折伴四肢瘫(AO:C3, Frankel A)蛛网膜下腔出血,头皮撕脱伤	是	150	150	病故

双侧侧块螺钉及 C₇-T₂ 双侧椎弓根螺钉联合固定。术中对固定节段的椎板、关节突均以磨钻打磨粗糙后植骨融合。

1.3 术后处理

术后常规予预防性使用抗生素 24~48 h, 术后前 3 d 予激素、脱水及抑酸药物等对症治疗, 一般于 24~48 h 拔除引流管; 术后第 4~7 天复查颈椎正侧位片及 CT 三维重建。患者卧床休息 6~8 周后, 在颈托或支具保护下下床进行康复锻炼。

2 结果

本组患者手术时间 150~320 min, 平均 246.3 min; 出血量 150~600 ml, 平均 307.5 ml。术后 1 例患者出现声音嘶哑, 未作特殊处理, 6 个月时基本恢复; 无

其他严重并发症发生。1 例 Frankel A 级患者于出院后 2 年因肺部感染去世, 其余患者均获随访, 平均随访时间 38.6 个月 (12~63 个月)。术后骨折脱位均获完全复位, 末次随访时患者骨折脱位均已愈合, 未见假关节形成。术后脊髓功能改善明显, 末次随访时 A 级中 1 例病故, 1 例脊髓功能无变化, B 级 2 例恢复到 C 级, D 级 1 例, C 级 1 例恢复到 D 级, D 级 3 例均恢复到 E 级。典型病例见图 1-2。

3 讨论

3.1 C₇T₁ 骨折脱位临床特点

C₇T₁ 处于颈椎生理前凸向胸椎生理后凸的过渡区域, 下方因有骨性胸廓固定活动度较下颈椎明显减小; 周围毗邻食管、气管、喉返神经、胸导管及出入

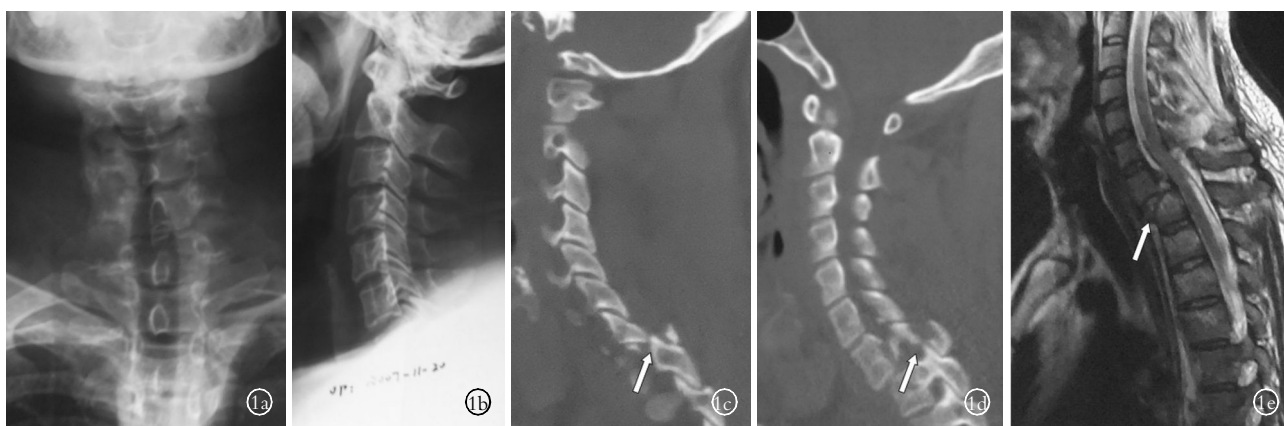


图 1 患者, 男, 37 岁, C₇T₁ 骨折脱位伴不全四肢瘫 (AO C1, Frankel D) 1a, 1b. 术前 X 线片未见明显骨折脱位征象 1c, 1d. 箭头显示 C₇T₁ 骨折脱位伴 C₇ 左侧关节突交锁、右侧关节突骨折 1e. 箭头显示颈椎间盘损伤

Fig. 1 37-year-old male patient diagnosed as C₇T₁ fracture-dislocation complicated with incomplete quadriplegia (AO C1, Frankel D) 1a, 1b. Preoperative X-ray films had no obvious signs of fracture and dislocation 1c, 1d. The arrows showed cervicothoracic junction (C₇T₁) fracture-dislocation with locked articular process and right fractured articular process 1e. The arrow showed the injured intervertebral disc



图 2 患者, 男, 37 岁, C₇T₁ 骨折脱位伴不全四肢瘫 (AO C1, Frankel D) 2a, 2b. 术后 1 周侧位 X 线片及 CT 二维重建, 箭头显示植入的松质骨颗粒 2c. 术后 30 个月游泳位片 2d, 2e. 术后 30 个月 CT 二维重建显示前后方植骨均已愈合

Fig. 2 37-year-old male patient diagnosed as C₇T₁ fracture-dislocation complicated with incomplete quadriplegia (AO C1, Frankel D) 2a, 2b. The lateral X-ray films and the two-dimensional CT reconstruction at 1 week after operation, the arrow showed the implanted cancellous bone particles 2c. The swimmer's view of X-ray film at 30 months after operation 2d, 2e. The two-dimensional CT reconstruction at 30 months after operation showed the fracture healed with bony union of the graft implanted anteriorly and posteriorly

心脏的大血管等重要结构^[1]。同时,该段椎管内容纳着脊髓颈膨大部分,又使得该段椎管相对其他节段狭窄。因而,该节段骨折脱位常伴有脊髓神经损伤^[4],在诊断、治疗上均较困难。

临床上,C₇T₁骨折脱位是一种少见且容易漏诊的脊柱创伤。文献报道 C₇T₁骨折脱位发生率占颈椎损伤的 2%~9%^[2-4],若仅凭颈椎正侧位片诊断则漏诊率高达 42.9%~86.4%^[3-4],在做游泳位 X 线片检查的患者中漏诊率仍然高达 12.5%。本组 8 例患者中除陈旧性骨折脱位 1 例患者外,仅 1 例由颈椎正侧位 X 线片诊断,X 线片漏诊率高达 85.7%。其原因除该节段骨折脱位临床表现与下颈椎骨折脱位相似外,与该节段在颈椎 X 线片上显影不清有很大关系。因此,在因颈肩部外伤而就诊的患者中,对颈椎 X 线片阴性而又高度怀疑存在颈椎损伤的患者,特别是颈部粗短的患者,有必要补充作颈胸段 CT 扫描等检查。此外,对于颅脑损伤意识不清的患者也应注意排除该节段的损伤。

3.2 C₇T₁骨折脱位的手术方式及入路选择

由于 C₇T₁独特的解剖特点,该节段骨折脱位在治疗上大多主张^[5-20]通过手术解除脊髓神经的压迫、恢复颈椎序列及重建颈椎稳定性;但是,在采用何种具体手术方式及手术入路上仍存在较大争议。

在手术方式选择上,Lenoir 等^[5]、Sapkak 等^[6]及国内部分学者^[7-10]主张通过后路进行 C₇T₁复位、固定,必要时作前路减压。而由于 C₇T₁骨折脱位大多合并有椎间盘损伤^[11-12],因此多数学者^[11-17]认为应通过前路手术进行彻底减压、复位并重建颈胸段稳定性,前路复位失败的则按前路-后路-再前路的手术方式处理^[13-14]。对于陈旧性骨折脱位,部分学者^[15,18-19]则主张直接采取前路-后路-再前路的手术方式来实现彻底减压与重建。

在手术入路选择上,C₇T₁骨折脱位的后方入路与普通下颈椎骨折脱位相似,多经后正中切口;而前方入路相对较为复杂。滕红林等^[20]结合患者术前颈椎 MRI 研究显示,多数患者经低位颈前方入路已足够满足手术操作需要,对于颈项特别粗短的患者,应结合患者受伤机制及影像资料恰当选择入路,必要时可考虑做胸骨柄切开等。虽然右侧喉返神经穿入内脏筋膜的位置较左侧高,但左侧颈动脉鞘后方走行有胸导管^[1],因此均有较高风险,在选择颈前方切口时应根据医师自身情况而定,而非一味选择左侧。本组患者均采用右侧颈前 Smith-Robinson 切口,术后虽 1 例患者出现声音嘶哑,但未作特殊处理,至术后 6 个月复查时基本恢复正常;可见,该入路能够满足 C₇T₁骨折脱位手术要求。

由于颈胸段骨折脱位多为三柱损伤,并且常伴有椎间盘损伤,笔者认为单纯前路或后路手术难以满足充分减压与安全复位的要求。因此,本组 8 例患者均尝试予 I 期前路切除脱位节段椎间盘并以颗粒状松质骨植骨融合及后路切开复位、固定与融合。该手术方式优点在于能够有效地避免复位过程中因损伤的椎间盘、后纵韧带及碎骨片等导致脊髓神经损伤加重的风险^[21];同时,在前方已行椎间盘切除并且无刚性结构固定的基础上进行后路复位与固定,简便易行,成功率高。

3.3 C₇T₁骨折脱位固定方式选择

Kreshak 等^[22]研究认为在颈胸段单纯前方钉板系统仅适用于前柱损伤;单纯后方 C₆、C₇侧块螺钉及 T₁、T₂椎弓根螺钉可有效满足 2 柱损伤的要求,但仍不足以满足三柱损伤的固定要求。Rhee 等^[23]研究表明 C₇T₁椎弓根螺钉固定与作 C_{6,7}侧块螺钉及 T_{1,2}椎弓根螺钉亦有相似的力学性能。O'Brien 等^[24]进一步研究表明 C₆侧块螺钉联合 C₇-T₂椎弓根螺钉固定可有效满足三柱损伤的固定要求,在此基础上使用横连接可进一步提高稳定性。本组患者前方不作固定,后方均采用此种方式固定,既获得了良好的术中即刻稳定性,又明显比前后路均作固定^[25]创伤小、费用低,同时也缩短了手术时间。此外,已有研究^[26]证实对于单节段颈前路椎间融合固定与否对融合率并无明显影响。

总之,C₇T₁骨折脱位是一种临床上较为少见的严重脊柱创伤,有必要对颈椎平片阴性而高度怀疑者补充作 CT 等检查,以免漏诊。在治疗上,可尝试 I 期前后路联合手术辅以非结构性植骨治疗。

参考文献

- [1] 杨新文,王勇,杨开明. 颈胸段脊柱椎体前方重要结构的解剖特点及其临床意义[J]. 中国临床解剖学杂志,2009,27(1):32-34. Yang XW, Wang Y, Yang KM. Anatomic features of the structures anterior to the cervicothoracic vertebral bodies and its clinical significance[J]. Zhongguo Lin Chuang Jie Pou Xue Za Zhi, 2009, 27(1): 32-34. Chinese.
- [2] Nichols CG, Young DH, Schiller WR. Evaluation of cervicothoracic junction injury[J]. Ann Emerg Med, 1987, 16(6): 640-642.
- [3] Gisbert VL, Hollerman JJ, Ney AL, et al. Incidence and diagnosis of C₇-T₁ fractures and subluxations in multiple-trauma patients: evaluation of the advanced trauma life support guidelines[J]. Surgery, 1989, 106(4): 702-709.
- [4] Amin A, Saifuddin A. Fractures and dislocations of the cervicothoracic junction[J]. J Spinal Disord Tech, 2005, 18(6): 499-505.
- [5] Lenoir T, Hoffmann E, Thevenin-Lemoine C, et al. Neurological and functional outcome after unstable cervicothoracic junction injury treated by posterior reduction and synthesis[J]. Spine J, 2006, 6(5): 507-513.
- [6] Sapkas G, Papadakis S, Katonis P, et al. Operative treatment of unstable injuries of the cervicothoracic junction[J]. Eur Spine J, 1999,

- 8(4):279-283.
- [7] 赵刘军,徐荣明,马维虎,等. 椎弓根螺钉在颈胸段骨折脱位中的临床运用[J]. 中国骨伤, 2009, 22(8):569-572.
Zhao LJ, Xu RM, Ma WH, et al. Application of the pedicle screws for cervicothoracic fracture-dislocation[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2009, 22(8):569-572. Chinese with abstract in English.
- [8] 马维虎,徐荣明,孙韶华,等. I 期前后联合手术减压固定治疗严重下颈椎疾病[J]. 中国骨伤, 2007, 20(3):148-151.
Ma WH, Xu RM, Sun SH, et al. One-stage operation through combined anterior and posterior approach for the treatment of severe lower cervical spine disease[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2007, 20(3):148-151. Chinese.
- [9] 刘立岷,宋跃明,刘浩,等. 后-前路联合手术治疗下颈椎骨折脱位伴关节突交锁[J]. 中华创伤杂志, 2007, 23(1):25-28.
Liu LM, Song YM, Liu H, et al. Posterior-anterior operation for treatment of cervical fracture-dislocation combined with facet dislocation[J]. Zhonghua Chuang Shang Za Zhi, 2007, 23(1):25-28. Chinese.
- [10] 陈剑明,胡勇,顾勇杰,等. I 期后-前路联合手术入路治疗下颈椎骨折脱位合并脊髓损伤的疗效分析[J]. 中国骨伤, 2010, 23(12):938-941.
Chen JM, Hu Y, Gu YJ, et al. Clinical analysis of one-stage posterior-anterior operative approach in treating lower cervical spine fracture and dislocation[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2010, 23(12):938-941. Chinese with abstract in English.
- [11] 陈华江,倪斌,袁文,等. 颈胸段严重骨折及脱位的前路外科治疗[J]. 中华创伤杂志, 2008, 24(3):212-215.
Chen HJ, Ni B, Yuan W, et al. Surgical treatment of severe cervicothoracic fracture and dislocation through anterior approach[J]. Zhonghua Chuang Shang Za Zhi, 2008, 24(3):212-215. Chinese.
- [12] Doran SE, Papadopoulos SM, Ducker TB, et al. Magnetic resonance imaging documentation of coexistent traumatic locked facets of the cervical spine and disc herniation[J]. J Neurosurg, 1993, 79(3):341-345.
- [13] Cao P, Liang Y, Gong Yc, et al. Therapeutic strategy for traumatic instability of subaxial cervical spine[J]. Chin Med J(Engl), 2008, 121(15):1364-1368.
- [14] 郝定均,贺宝荣,吴起宁,等. 颈胸段脊柱骨折的外科治疗[J]. 中国骨伤, 2009, 22(8):580-582.
Hao DJ, He BR, Wu QN, et al. Characteristic and surgical treatment of cervicothoracic spine fracture[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2009, 22(8):580-582. Chinese with abstract in English.
- [15] 谢世明,刘浩,李涛,等. 前路、后路再前路 I 期治疗颈椎小关节交锁合并颈脊髓损伤[J]. 中华创伤骨科杂志, 2006, 8(11):1097-1098.
Xie SM, Liu H, Li T, et al. One-stage operation through anterior-posterior-anterior approach for the treatment of cervical spinal injury combined with articular process interlocking[J]. Zhonghua Chuang Shang Gu Ke Za Zhi, 2006, 8(11):1097-1098. Chinese.
- [16] 肖建如,李文平,魏海峰,等. 颈胸段脊柱损伤的临床特点及其前路手术疗效探讨[J]. 中华创伤杂志, 2007, 17(11):662-665.
Xiao JR, Li WP, Wei HF, et al. Investigation of clinical characteristics of cervicothoracic spine trauma and the effect of anterior operation of cervicothoracic spine junction[J]. Zhonghua Chuang Shang Za Zhi, 2007, 17(11):662-665. Chinese.
- [17] Feng G, Hong Y, Li L, et al. Anterior decompression and non-structural bone grafting and posterior fixation for cervical facet dislocation with traumatic disc herniation[J]. Spine (Phila Pa 1976), 2012, 37(25):2082-2088.
- [18] Payer M, Tessitore E. Delayed surgical management of a traumatic bilateral cervical facet dislocation by an anterior-posterior-anterior approach[J]. J Clin Neuro Sci, 2007, 14(8):782-786.
- [19] 黄亚增,陈锦平,李晓林,等. 后路有限固定的前后路联合治疗陈旧性下颈椎交锁脱位[J]. 中国骨伤, 2011, 24(10):864-868.
Huang YZ, Chen JP, Li XL, et al. Anterior-posterior operation with posteriorly limited fixation for the irreducible old dislocation of the inferior cervical vertebra combined with tiny joint interlocking[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2011, 24(10):864-868. Chinese with abstract in English.
- [20] 腾红林,贾连顺,肖建如,等. MRI 测量颈胸角在选择颈胸段脊柱手术入路中的临床应用[J]. 中国骨伤, 2004, 17(6):325-328.
Teng HL, Jia LS, Xiao JR, et al. Clinical application of MRI measurement for selecting the optimal approach in 76 patients with cervicothoracic junction diseases[J]. Zhongguo Gu Shang/China J Orthop Trauma, 2004, 17(6):325-328. Chinese with abstract in English.
- [21] Robertson PA, Ryan MD. Neurological deterioration after reduction of cervical subluxation. Mechanical compression by disc tissue[J]. J Bone Joint Surg Br, 1992, 74(2):224-227.
- [22] Kreshak JL, Kim DH, Lindsey DP, et al. Posterior stabilization at the cervicothoracic junction: a biomechanical study[J]. Spine (Phila Pa 1976), 2002, 27(24):2763-2770.
- [23] Rhee JM, Kraiwattanapong C, Hutton WC. A comparison of pedicle and lateral mass screw construct stiffnesses at the cervicothoracic Junction[J]. Spine (Phila Pa 1976), 2005, 30(21):E636-640.
- [24] O'Brien JR, Dmitriev AE, Yu W, et al. Posterior-only stabilization of 2-column and 3-column injuries at the cervicothoracic junction: a biomechanical study[J]. J Spinal Disord Tech, 2009, 22(5):340-346.
- [25] 林旭,刘浩,龚全,等. 闭合复位结合 I 期前后路内固定治疗下颈椎骨折脱位[J]. 中国骨与关节损伤杂志, 2006, 21(4):244-246.
Lin X, Liu H, Gong Q, et al. Treatment of fracture and dislocation of lower cervical spine with closed reduction and primary internal fixation through anterior and posterior approaches[J]. Zhongguo Gu Yu Guan Jie Sun Shang Za Zhi, 2006, 21(4):244-246. Chinese.
- [26] Wright IP, Eisenstein SM. Anterior cervical discectomy and fusion without instrumentation[J]. Spine (Phila Pa 1976), 2007, 32(7):772-775.

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