

• 临床研究 •

桡骨远端骨折内固定术中两透视方式比较[△]

刘恒山^a, 寿康全^b, 朱高波^{a*}

[三峡大学第一临床医学院(宜昌市中心人民医院) a: 急诊与创伤外科; b: 骨科, 湖北宜昌 443003]

摘要: [目的] 探讨桡骨远端骨折掌侧钢板内固定术中行腕管位透视 (carpal shoot through view, CSTV) 与背侧切线位透视 (dorsal tangential view, DTV) 的应用效果。[方法] 2019年1月—2023年1月, 50例桡骨远端骨折患者纳入本研究。依据术前医患沟通结果, 分为CSTV组和DTV组, 每组25例。比较两组临床与影像结果。[结果] 两组手术时间、切口长度、术中失血量差异均无统计学意义 ($P>0.05$)。随访时间平均 (12.7 ± 3.4) 个月, 末次随访, 两组患者腕伸-屈 ROM、桡-尺偏 ROM、Gartland-Werley 评分差异均无统计学意义 ($P>0.05$)。影像方面, CSTV组透视次数 [(1.9 ± 0.8) 次 *vs* (2.7 ± 1.2) 次, $P=0.008$] 显著少于DTV组。两组术中穿透钉检出率的差异无统计学意义 ($P>0.05$)。两组均无穿透钉漏检者。[结论] 掌侧钢板内固定治疗桡骨远端骨折术中行CSTV和DTV均能有效检测出穿出桡骨远端背侧皮质螺钉, CSTV组透视次数少于DTV组。

关键词: 桡骨远端骨折, 开放内固定, 掌侧钢板, 腕管位, 背侧切线位

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Comparison of two fluoroscopy position in internal fixation of distal radius fractures // LIU Heng-shan^a, SHOU Kang-quan^b, ZHU Gao-bo^a. a. Department of Emergency and Trauma, b. Department of Orthopedics, Central People's Hospital of Yichang City, Yichang, Hubei 443003, China

Abstract: [Objective] To investigate the clinical efficacy of carpal shoot through view (CSTV) and dorsal tangential view (DTV) of fluoroscopy during open reduction and internal fixation (ORIF) with plate for distal radius fractures. [Methods] From January 2019 to January 2023, 50 patients with distal radius fractures were included in this study. According to the preoperative doctor-patient communication, the patients were divided into CSTV group and DTV group, with 25 cases in each group. Clinical and imaging data were compared between the two groups. [Results] There were no significant differences in operation time, incision length and intraoperative blood loss between the two groups ($P>0.05$). At the last follow-up lasted for a mean of (12.7 ± 3.4) months, there were no significant differences in wrist extension-flexion range of motion (ROM), radio-ulnar deviation ROM and Gartland-Werley scores between the two groups ($P>0.05$). In term of imaging, the fluoroscopy times in CSTV group were significantly less than that in DTV group [(1.9 ± 0.8) *vs* (2.7 ± 1.2), $P=0.008$]. There was no a significant difference in the detection rate of penetrating screw between the two groups ($P>0.05$), and no penetrating screw was missed in both groups. [Conclusion] Both CSTV and DTV positions can effectively detect the screw penetrating the dorsal cortex of the distal radius during ORIF of distal radius fracture with palmar plate, however, the fluoroscopy times in CSTV group is less than that in DTV group.

Key words: distal radius fracture, open reduction and internal fixation, palmar plate, carpal shoot through view, dorsal tangential view

桡骨远端骨折临床常见, 大部分不稳定的桡骨远端骨折可经掌侧入路钢板固定获得良好的复位及固定^[1, 2]。然而术后螺钉过长, 突破背侧骨皮质导致伸肌腱相关并发症 (包括肌腱激惹引起的疼痛、腱鞘炎, 甚至伸肌腱断裂) 也时有报道, 据报道其发生率为0%~12.5%^[3, 4]。同时由于Lister结节的遮挡使术中正、侧位透视难以准确辨识螺钉是否穿出背侧皮质^[5]。为解决这一问题, Haug等^[6]提出腕关节掌屈

体位下行X线透视的方法, 称之为“背侧切线位透视法” (dorsal tangential view, DTV)。与此体位相反, Marsland等^[7]提出背伸腕关节体位下进行透视, 刘涛等^[8]对该透视方法进行优化改良的“腕管位透视法” (carpal shoot through view, CSTV)。本研究比较两种透视方法在桡骨远端骨折掌侧钢板内固定术中检测螺钉穿出的临床疗效, 报告如下。

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作者简介:刘恒山, 主治医师, 研究方向:创伤骨科, (电子信箱)540653335@qq.com

* 通信作者:朱高波, (电子信箱)doctorzhu1208@163.com

1 临床资料

1.1 一般资料

回顾性分析本院2019年1月—2023年1月手术治疗的50例桡骨远端骨折患者的临床资料。依据术前医患沟通结果,分为CSTV组和DTV组,每组各25例。两组患者一般资料见表1。两组患者年龄、性别、身体质量指数(body mass index, BMI)、损伤至手术时间、骨折AO分型比较的差异均无统计意义($P>0.05$)。该研究通过医院医学伦理委员会审批,所有患者及家属均知情同意。

1.2 手术与透视方法

两组手术均由同一主刀医师完成。手术方法:臂丛神经阻滞麻醉或全身麻醉,患者取平卧位,上臂应用止血带后外展位放置于手术台上。Henry入路,经腕屈肌桡侧切口进入,注意保护桡动脉及正中神经,切开旋前方肌桡侧,骨膜下推开旋前方肌。清理显露骨折断端后行牵引复位,恢复骨折块间对位、关节面、掌倾角及尺偏角,同时用临时克氏针固定。选取适宜的解剖锁定钢板,用1枚皮质骨螺钉和克氏针临时固定接骨板,经X线透视评估钢板长度位置满意。所有的钉孔使用电钻行双皮质钻孔、测深尺测深后一次性置入剩余锁定螺钉,取出临时固定克氏针。术中透视方法分别如下:

CSTV组:患者取平卧位,上肢外展放置于手术桌上,上臂与躯干垂直,屈曲肘关节与上臂呈 $110^{\circ}\sim 120^{\circ}$ 角,前臂尽量旋后,腕关节尽量背伸,射线指向大鱼际底部,射线与前臂呈约 20° 角(图1)。

DTV组:患者取平卧位,上肢外展放置于手术桌上,上臂与躯干垂直,屈曲肘关节与上臂夹角约 105° ,前臂最大限度旋前,屈曲腕关节约 60° ,射线与前臂夹角约 15° (图2)。

若发现螺钉穿出更换短螺钉后再分别行CSTV或DTV确认,至无螺钉穿出后,止血、冲洗后缝合切口并敷料包扎。围手术期预防性使用抗生素24h,给予镇痛、消肿对症治疗,术后指导腕关节功能康复锻炼。

1.3 评价指标

记录患者围手术期资料,包括手术时间、切口长度、术中失血量。采用Gartland-Werley评分、腕关节掌屈-背伸活动度(range of motion, ROM)、桡偏-尺偏ROM评价关节功能情况,记录术后并发症发生情况。影像方面,记录术中透视次数、检出远排螺钉

穿出背侧皮质数量及远排螺钉置入数量。所有患者术后次日行腕关节CT检查,明确是否有螺钉穿出背侧皮质并记录。

1.4 统计学方法

采用SPSS 20.0统计软件进行数据分析,计量资料以 $\bar{x}\pm s$ 表示,资料呈正态分布时,两组间比较采用独立样本 t 检验;资料呈非正态分布时,采用秩和检验。计数资料采用 χ^2 检验,以 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 临床结果

两组患者手术过程顺利,术中均无血管、神经损伤等并发症发生。两组围手术期资料见表1,两组手术时间、切口长度、术中失血量差异无统计学意义($P>0.05$)。50例患者均获得随访,随访时间9~14个月,平均(12.7 ± 3.4)个月。随访期间所有患者未出现腕背侧疼痛、腱鞘炎等伸肌腱激惹症状,无需再次手术者。两组患者末次随访资料见表1。末次随访时,两组患者腕伸-屈ROM、桡-尺偏ROM、Gartland-Werley评分差异均无统计学意义($P>0.05$)。

2.2 影像评估

CSTV组透视次数显著少于DTV组($P<0.05$)。50例患者共置入298枚桡骨远端远排螺钉,通过CSTV和DTV术中共检测出30枚螺钉穿出背侧皮质并更换,总检出率为10.1%。CSTV组25例患者共置入156枚桡骨远端远排螺钉,术中共检测出17枚掌侧螺钉穿出背侧皮质并更换,检出螺钉穿出率为10.1%。DTV组25例患者共置入142枚桡骨远端远排螺钉,术中共检测出13枚穿出背侧远排螺钉并更换,检出螺钉穿出率为9.2%。两种方法术中穿透钉检出率的差异无统计学意义($P>0.05$)。所有患者术后行腕关节CT检查,未见穿出桡骨远端背侧骨皮质远排螺钉,两组均无穿透钉漏检者。末次随访时两组骨折均对位对线良好,无骨折不愈合、骨折移位等并发症发生。

3 讨论

桡骨远端背侧存在凸起的Lister结节及若干条伸肌腱沟^[9]。应用掌侧钢板治疗桡骨远端骨折,术中正侧位X线透视时,因背侧不规则骨皮质遮挡,无法准确显示背侧螺钉是否穿出^[5]。Maschke等^[10]报道

标准侧位透视下穿出背侧皮质 6.5 mm 的螺钉可能被 Lister 结节所遮挡。目前临床骨科医师为避免螺钉穿出背侧骨皮质，通常经验性采用测深尺测量后适量减少螺钉长度来避免螺钉穿出^[11]。该方法有一定的临床应用效果，但在背侧粉碎骨折时存在准确度降

低^[12]、经验性及测量误差等。掌侧入路治疗桡骨远端骨折时，术中如何获得桡骨远端背侧皮质清晰透视影像仍是一项挑战。为解决这一问题，有学者提出在术中行 CSTV 或 DTV 透视，目前此两种透视方法的有效性已被实验室及部分临床研究证实^[6-8, 13, 14]。

表 1. 两组患者临床和影像资料比较
Table 1. Comparison of clinical and imaging data between the two groups

指标	CSTV 组 (n=25)	DTV 组 (n=25)	P 值
一般资料			
年龄 (岁, $\bar{x} \pm s$)	55.8±18.2	53.8±16.9	0.689
性别 (例, 男/女)	15/10	14/11	0.774
BMI (kg/m ² , $\bar{x} \pm s$)	24.6±6.9	25.7±7.1	0.581
损伤至手术时间 (d, $\bar{x} \pm s$)	3.8±2.4	4.0±2.9	0.792
AO 分型 (例, B/C 型)	8/17	9/16	0.765
临床资料			
手术时间 (min, $\bar{x} \pm s$)	59.5±9.8	58.6±12.4	0.777
切口长度 (cm, $\bar{x} \pm s$)	6.5±1.8	6.3±1.7	0.688
术中失血量 (mL, $\bar{x} \pm s$)	40.8±10.6	38.9±13.2	0.577
末次随访伸-屈 ROM (°, $\bar{x} \pm s$)	134.6±8.6	136.9±9.7	0.379
末次随访桡-尺偏 ROM (°, $\bar{x} \pm s$)	124.4±3.8	125.9±4.7	0.221
末次随访 G-W 评分 (分, $\bar{x} \pm s$)	2.5±1.2	2.6±1.4	0.787
影像资料			
术中透视次数 (次, $\bar{x} \pm s$)	1.9±0.8	2.7±1.2	0.008
术中穿透螺钉检出 [例 (%)]	17 (10.1)	13 (9.2)	0.652
穿透钉漏检 [例 (%)]	0	0	—

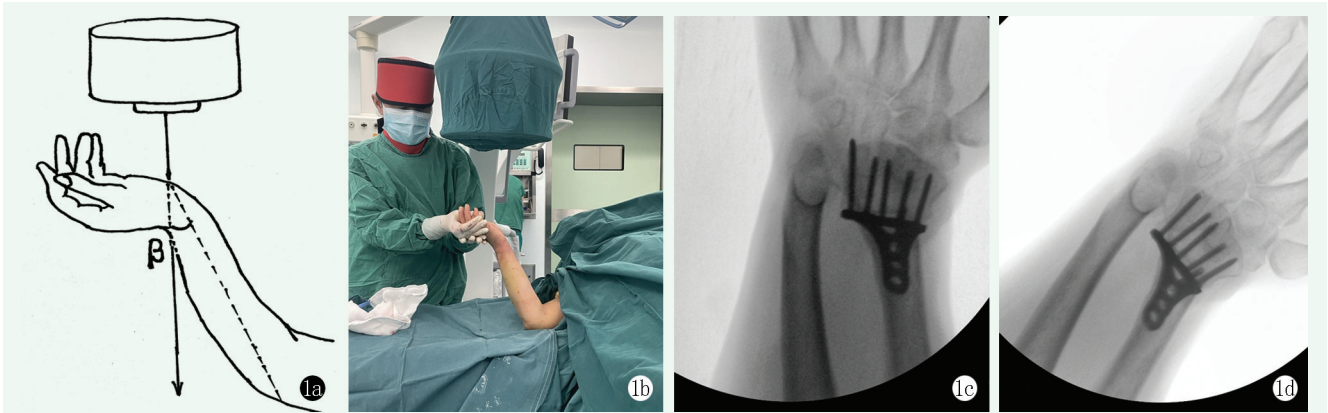


图 1. CSTV 术中透视法。1a: CSTV 透视法示意图, $\angle\beta=15^\circ$; 1b: CSTV 透视术中操作图; 1c: CSTV 透视可见尺侧第 1 枚螺钉穿出背侧骨皮质; 1d: 更换短螺钉后再次行 CSTV 透视, 未见螺钉穿出。

Figure 1. Intraoperative fluoroscopy in carpal shoot through view (CSTV). 1a: Schematic diagram of CSTV fluoroscopy with $\angle\beta=15^\circ$; 1b: Real fluoroscopy in CSTV intraoperatively; 1c: Fluoroscopy in CSTV shows that the first screw on the ulnar side penetrated the dorsal bone cortex; 1d: After replacing the short screw, fluoroscopy in CSTV confirmed no screw penetrated.

本组 50 例患者术中共检测出 30 枚螺钉穿出背侧骨皮质并更换，所有患者术后 CT 检查未发现穿出桡骨远端背侧皮质螺钉，说明 CSTV 和 DTV 均能有效检测出穿透背侧皮质螺钉。CSTV 组获得满意影像的透视次数显著少于 DTV 组 ($P<0.05$)。笔者实践中发

现，DTV 透视的缺点在于术中容易出现图像的过度曝光，C 形臂 X 线机的自动曝光功能会根据透视物体的密度调节辐射剂量。DTV 透视的桡骨远端骨质和空气之间的密度差异较大，容易出现过度曝光从而致使图像模糊^[12]，术中可能需多次透视才能获得满

意的图像^[12]。其次,本研究 CSTV 组采用刘涛等^[8]改良的腕管位透视法,该方法可复制性强、容易获得良好的透视图像。此外,文献报道 CSTV 及 DTV 也能较好显示下尺桡关节^[7]的乙状切迹,对螺钉穿入尺桡关节能提供有价值的影像学信息^[7, 8]。上述两种

透视方法可以有效检测出正侧位透视所不能发现的背侧骨皮质螺钉穿出,但正侧位透视在评估钢板放置位置、骨折复位情况等方面是 CSTV 和 DTV 无法替代的。



图 2. DTV 术中透视法。2a: DTV 透视法示意图, $\angle\alpha=20^\circ$; 2b: DTV 透视术中操作图; 2c: 术中行 DTV 透视显示尺侧第 1 枚螺钉穿出背侧骨皮质; 2d: 更换短螺钉后再次 DTV 透视, 未见螺钉穿出。

Figure 2. Intraoperative fluoroscopy in dorsal tangential view (DTV). 2a: Schematic diagram of fluoroscopy in DTV, with $\angle\alpha=20^\circ$; 2b: Position of DTV fluoroscopy in the real operation; 2c: Fluoroscopy in DTV showed that the first screw on the ulnar side penetrated the dorsal cortex; 2d: After replacing the short screw, fluoroscopy in DTV verified no screw penetrated.

综上所述,掌侧钢板内固定治疗桡骨远端骨折术中行 CSTV 和 DTV 均能有效检测出穿出桡骨远端背侧骨皮质螺钉, CSTV 组透视次数少于 DTV 组, CSTV 更容易获得满意的透视图像,值得进一步研究实践。

利益冲突声明 所有作者声明无利益冲突

作者贡献声明 刘恒山: 课题实施和论文写作、采集分析和解释数据、统计分析; 寿康全: 课题设计、实施、采集数据、行政或技术及材料支持、统计分析; 朱高波: 论文审阅、行政或技术及材料支持、支持性贡献

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