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前环经皮 Infix 固定联合后路固定治疗垂直不稳定骨盆骨折的效果*

陈华东¹ 尚学红¹ 何建荣² 赵宇¹ 杨保家²

(1 大理大学第一附属医院创伤骨科 云南 大理 671000; 2 大理大学第一附属医院脊柱外科 云南 大理 671000)

摘要 目的:探讨前环经皮内固定架(Infix)固定联合后路固定治疗垂直不稳定骨盆骨折的效果。**方法:**采用回顾性方法,选择本院2013年8月到2018年2月诊治的垂直不稳定骨盆骨折患者61例患者,根据手术方法的不同分为观察组31例与对照组30例,对照组给予钢板内固定治疗,观察组给予前环经皮 Infix 固定联合后路固定,记录与观察两组预后。**结果:**所有患者都完成手术,术中无严重并发症发生,观察组的切口长度、术中出血量与骨折愈合时间显著少于对照组($P<0.05$),两组手术时间与术中透视次数对比差异无统计学意义($P>0.05$)。观察组术后1个月的钉道感染、神经损伤、静脉血栓、切口感染发生率低于对照组(6.5% vs. 33.3%, $P<0.05$)。观察组与对照组术后3个月的Majeed评分优良率分别为93.5%和73.3%,骨折复位优良率分别为96.8%和73.3%,观察组高于对照组($P<0.05$)。**结论:**前环经皮 Infix 固定联合后路骶髂关节螺钉固定治疗垂直不稳定骨盆骨折能减少创伤,促进骨折愈合,减少术后并发症的发生,提高骨盆复位质量与骨盆功能。

关键词:Infix 固定;骶髂关节;垂直不稳定骨盆骨折;骨盆功能

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Anterior Loop Percutaneous Infix Fixation Combined with Posterior Sacroiliac Screw Fixation for Vertically Unstable Pelvic Fractures*

CHEN Hua-dong¹, SHANG Xue-hong¹, HE Jian-rong², ZHAO Yu¹, YANG Bao-jia²

(1 Department of Orthopaedic Trauma, the First Affiliated Hospital of Dali University, Dali, Yunnan, 671000, China;

2 Department of Spine Surgery, the First Affiliated Hospital of Dali University, Dali, Yunnan, 671000, China)

ABSTRACT Objective: To investigate the effect of anterior loop Infix fixation combined with posterior sacroiliac screw fixation for vertically unstable pelvic fractures. **Methods:** From August 2013 to February 2018, used the retrospective and summary study methods, 61 cases of vertically unstable pelvic fractures were selected and were divided into the 31 cases in the observation group and 30 cases in the control group accorded to the different surgical methods. The control group were treated with steel plate internal fixation, and the observation group were given the anterior loop percutaneous Infix fixation combined with posterior sacroiliac screw fixation, recorded and observed the prognosis of the two groups. **Results:** All the patients were completed the operation and without serious complications, the length of the incision, the amount of bleeding and the healing time of the fracture in the observation group were significantly less than that of the control group ($P<0.05$), there were no significant difference compared between the two groups of operation time and the frequency of intraoperative fluoroscopy ($P>0.05$). The postoperative 1 month of incidence of complications such as nail tract infection, nerve injury, ossifying myositis and incision infection in the observation group were lower than the control group (6.5% vs. 33.3%, $P<0.05$). The postoperative 1 months of excellent rate of Majeed score of the observation group and the control group were 93.5% and 73.3% respectively, the excellent rate of fracture reduction were 96.8% and 73.3%, respectively, and the observation group were higher than the control group ($P<0.05$). **Conclusion:** The anterior ring Infix fixation combined with posterior sacroiliac screw fixation for vertically vertical unstable pelvic fracture can reduce trauma, promote fracture healing, reduce postoperative complications, improve pelvic reduction quality and pelvic function.

Key words: Infix fixation; Sacroiliac joint; Vertically unstable pelvic fracture; Pelvic function

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前言

骨盆是连接脊柱与多数负重运动结构的主要环节,骨盆环

是一个完整环形结构,其中韧带结构对维护骨盆稳定性发挥重要作用^[1,2]。垂直不稳定骨盆骨折是一种急危重的损伤,是由于骨和韧带的损伤移位所造成的后环骶髂关节复合结构的骨折^[3-5]。

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作者简介:陈华东(1979-),男,硕士,副主任医师,研究方向:创伤骨科,电话:13508729938, E-mail:chenhuadong2019@sina.com

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该病有很高的致死率和致残率,治疗不当也容易发生下肢不等长、骨盆畸形愈合等并发症^[6,7]。骨盆骨折的手术方法包括外固定支架固定、钉棒固定、钢板固定、接骨板固定、螺钉固定等^[8,9]。其中常规内固定方法虽然可促使骨盆解剖复位恢复正常,提供可靠的生物力学支持,给予骨盆稳定的内固定,但是对于患者的创伤比较大^[10,11]。经皮椎弓根钉棒系统即皮下内固定架(Infix)联合骶髂螺钉治疗骨盆骨折可实现前环与后路同时固定,具有很好的微创性^[12,13],但是在垂直不稳定骨盆骨折中的应用尚无相关报道。本文具体探讨了前环经皮 Infix 固定联合后路骶髂关节螺钉固定治疗垂直不稳定骨盆骨折的效果,以促进改善患者预后。

1 资料与方法

1.1 研究对象

选择本院 2013 年 8 月至 2018 年 2 月诊治的垂直不稳定骨盆骨折患者 61 例,纳入标准:年龄 ≥ 18 岁,具有手术治疗指征;临床资料完整;生命体征平稳,神志清晰,知情同意本研究;术前影像学诊断为不稳定骨盆骨折,术中得到确诊;从受伤到手术的时间 ≤ 2 周;医院伦理委员会批准了此次研究。排除标准:合并内科严重疾病者;精神疾病者;妊娠与哺乳期妇女;合并恶性肿瘤者。根据手术方法分为两组,两组一般资料有可比性。见表 1。

表 1 一般资料对比

Table 1 General information comparison

Groups	n	Gender (male / female)	Age (years)	BMI(kg/m ²)	Fracture classification (A/B/C)	Admission to operation time(d)	Cause of fracture (car accident injury / fall injury / crush injury)
Observation group	31	16/15	51.44 $\pm$ 4.24	22.84 $\pm$ 2.14	11/10/10	8.67 $\pm$ 2.34	17/10/4
Control group	30	15/15	51.33 $\pm$ 3.92	22.19 $\pm$ 1.84	12/8/10	8.51 $\pm$ 1.98	15/10/5

1.2 治疗方法

两组在术前积极救治危及生命的内脏损伤、出血性休克等并发症,用骨盆带捆扎、减少髋关节活动、沙袋侧方挤压等暂时稳定骨折,在抗休克的基础上早期探查治疗,用骨盆带捆扎,术前重视心理干预护理,常规抗感染治疗,采用全身麻醉或连续硬膜外麻醉。

对照组:给予钢板内固定治疗,患者俯卧位,皮肤消毒、铺巾,自两侧髂后上嵴向下顺髂嵴做两各弧形切口,长度 5-7 cm,逐层切开皮肤、皮下组织等,显露骶髂关节,剥离肌肉和韧带,对骨折部位进行复位。将重建钢板进行预弯成型,穿越骶骨后的皮下隧道,按钢板的远端指向耻骨联合的方向进行安装,固定 3 枚左右螺钉。

观察组:给予前环经皮 Infix 固定联合后路骶髂关节螺钉固定,患者仰卧位,于两侧髂前上棘打入 Schanz 钉辅助复位骨盆骨折,满意后于 C 形臂辅助下打入空心钉导针固定骶髂关节,确认位置准确后拧入直径 7.3 mm 空心螺钉固定。以髂前下棘为中心作 2-3 cm 斜形切口,钝性分离深筋膜切开后软组织。C 形臂透视确认进针的方向,打入合适长度的椎弓根螺钉,在深筋膜上建立皮下隧道建立,前环复位可行手法复位。在耻骨联合上方做横切口,在皮下组织建立皮下隧道,将连接杆经皮下隧道放入椎弓根螺钉尾端的"U"形槽内。在加压状态下锁紧螺钉尾帽,以使骨折复位。

两组都鼓励患者术后进行早期功能锻炼,术后 3-7 d 床上被动锻炼,2 周后不负重扶拐下地锻炼。所有手术由同一组医生完成。

1.3 观察指标

(1)两组的围手术指标(手术时间、切口长度、透视次数、出血量、骨折愈合时间)。(2)两组术后 1 个月的钉道感染、神经损伤、骨化性肌炎、切口感染等并发症发生情况。(3)在术后 3 个月采用 Majeed 评分评定骨盆功能, ≥ 85 分为优,70-84 分为良,60-69 分为中, <60 分为差,(优+良)/组内例数 $\times 100.0\%$ =优良率。(4)在术后 3 个月根据 Matta 标准评定骨折复位质量,优:骨盆骨折断端最大移位 <4 mm;良:移位为 4-10 mm;可:移位为 11-20 mm;差:移位 >20 mm。(优+良)/组内例数 $\times 100.0\%$ =优良率。

1.4 统计方法

选择 SPSS 19.00,计量数据采用($\bar{x} \pm s$),行 t 检验;计数数据采用%表示,行卡方分析, $P < 0.05$ 有统计学意义。

2 结果

2.1 围手术指标对比

观察组切口长度、术中出血量与骨折愈合时间显著少于对照组($P < 0.05$),两组手术时间与术中透视次数对比无显著差异($P > 0.05$)。见表 2。

表 2 围手术指标对比($\bar{x} \pm s$)

Table 2 Comparison of perioperative indicators ($\bar{x} \pm s$)

Groups	n	Operation time (min)	Intraoperative bleeding volume(mL)	Incision length (cm)	Intraoperative perspective (times)	Fracture healing time (w)
Observation group	31	123.29 $\pm$ 14.22	127.30 $\pm$ 15.3	2.78 $\pm$ 0.35	4.84 $\pm$ 2.44	12.22 $\pm$ 2.45
Control group	30	128.29 $\pm$ 19.53	197.87 $\pm$ 1.44*	6.39 $\pm$ 0.91*	4.29 $\pm$ 2.77	18.77 $\pm$ 3.11*

Note: Compared with the observation group, * $P < 0.05$, the same below.

2.2 术后并发症对比

组 33.3 % ($P < 0.05$)。见表 3。

观察组术后 1 个月并发症发生率位 6.5 %，显著低于对照

表 3 术后并发症发生情况对比(例,%)

Table 3 Comparison of postoperative complications (n,%)

Groups	n	Nail canal infection	Nerve damage	Venous thrombus	Infection of wound	Total
Observation group	31	0	0	1	1	2(6.5)
Control group	30	2	2	3	3	10(33.3)*

2.3 骨盆功能优良率对比

93.5 %和 73.3 %，差异显著($P < 0.05$)。见表 4。

观察组与对照组术后 3 个月 Majeed 评分优良率分别为

表 4 Majeed 评分优良率对比(例,%)

Table 4 Comparison of excellent rate of Majeed scores (n,%)

Groups	n	Excellent	Good	Medium	Poor	Excellent rate
Observation group	31	20	9	1	1	29(93.5)
Control group	30	6	14	2	8	22(73.3)*

2.4 骨折复位优良率对比

96.8 %和 73.3 %，差异显著($P < 0.05$)。见表 5。

观察组与对照组术后 3 个月的骨折复位优良率分别为

表 5 骨折复位优良率对比(例,%)

Table 5 Comparison of excellent rate of fracture reduction (n,%)

Groups	n	Excellent	Good	Medium	Poor	Excellent rate
Observation group	31	26	4	1	0	30(96.8)
Control group	30	8	14	4	6	22(73.3)*

3 讨论

骨盆前方由耻骨联合连接,后方由左右骶髂关节连接。盆腔内有很多重要脏器及神经血管,骨盆保护着这些结构不受损伤^[14-16]。不稳定骨盆骨折,常伴有神经、血管及内脏损伤等合并伤。该病的治疗原则为控制出血,减少骨盆垂直与旋转移位和再损伤稳定骨折,降低致残率与死亡率^[17-19]。

钢板内固定为骨盆骨折的传统治疗方法,可对骨盆环进行解剖重建和对称重建,但创伤较大^[20-21]。Infix 骨盆前环固定仅需作髂前下棘水平的斜切口,解剖简单。本研究显示观察组切口长度、术中出血量与骨折愈合时间显著少于对照组。说明联合前环经皮 Infix 固定不会增加患者的手术时间,不增加术中出血量,有利于患者骨折愈合,主要原因前环经皮 Infix 固定属于微创内固定方法,创伤小,避免了外固定常见的针道感染,同时对患者的稳定性比较好,术后护理方便,患者感觉舒适,不会对骶骨产生压迫作用,有利于恢复机体的神经功能,加快了骨折的愈合^[22]。

骨盆的稳定性除了依赖于骨结构,手术可最大限度地复位固定骨折,恢复骨盆的解剖形态,但是对患者侧卧、俯卧、坐起、行走影响较大,术后存在一定的并发症^[23-24]。本研究显示观察组术后 1 个月的钉道感染、神经损伤、骨化性肌炎、切口感染发生率低于对照组,说明联合前环经皮 Infix 固定,能显著降低不良

发症的发生率,主要是微创内固定,切口小,减少了针道感染和切口的感染,同时对骶骨压迫小,减轻对神经的损伤程度,从而降低了骨化性肌炎的发生率,但是也有研究显示,术后股外侧皮神经损伤率为 19.4 %^[25],因此术中应注意在肌间隙钝性分离,避免过度牵拉损伤股外侧皮神经^[26]。

本研究显示观察组术后 3 个月的骨折复位优良率和高于对照组,说明联合前环经皮 Infix 固定,有利于骨折复位。研究显示^[27,28],对于骨盆旋转不稳定者,单纯应用前环固定,复位丢失率为 20 %左右,如果同时进行后路固定,则复位丢失率可降到 5 %左右,因此在手术时,选择固定的位置,显得十分重要。本研究显示观察组术后 3 个月的 Majeed 评分优良率显著高于对照组,说明联合前环经皮 Infix 固定,有利于骨盆功能的恢复,有研究显示 Infix 固定组优于外固定组,特别是应用 Infix 时固定强度显著高于万向椎弓根钉,符合生物力学要求,可以获得较好的临床效果^[29-31]。本研究也存在一定的不足,没有进行随访分析,且纳入病例数目也比较少,将在后续研究中深入分析。

总之,前环经皮 Infix 固定联合后路骶髂关节螺钉固定治疗垂直不稳定骨盆骨折能减少创伤,促进骨折愈合,减少术后并发症的发生,提高骨盆复位质量与骨盆功能。

参考文献(References)

- [1] Ebeling PA, Clark C, Erwin D, et al. Femoral Head Dislocation into the Rectum Following Blunt Trauma [J]. Cureus, 2019, 11(5): e4596

- [2] Jordan M C, Brems A C, Heintel T, et al. The Anterior Subcutaneous Pelvic Ring Fixator: No Biomechanical Advantages Compared with External Fixation[J]. *J Bone Joint Surg Am*, 2019, 101(19): 1724-1731
- [3] Oh HK, Choo SK, Kim JJ, et al. Stoppa Approach for Anterior Plate Fixation in Unstable Pelvic Ring Injury[J]. *Clin Orthop Surg*, 2016, 8(3): 243-248
- [4] Lea W B, Neilson J C, King D M, et al. Minimally Invasive Stabilization Using Screws and Cement for Pelvic Metastases: Technical Considerations for the Pelvic "Screw and Glue" Technique [J]. *Semin Intervent Radiol*, 2019, 36(3): 229-240
- [5] Shetty AP, Bosco A, Perumal R, et al. Midterm radiologic and functional outcomes of minimally-invasive fixation of unstable pelvic fractures using anterior internal fixator (INFIX) and percutaneous iliosacral screws[J]. *J Clin Orthop Trauma*, 2017, 8(3): 241-248
- [6] Hua X, Yan SG, Cui Y, et al. Minimally invasive internal fixator for unstable pelvic ring injuries with a pedicle screw-rod system: a retrospective study of 23 patients after 13.5 months[J]. *Arch Orthop Trauma Surg*, 2019, 139(4): 489-496
- [7] Jain M, Nanda S N, Mohapatra S S, et al. Bladder incarceration following anterior pelvic infix of a traumatic pubic symphysis diastasis treated with immediate open reduction and internal fixation[J]. *J Clin Orthop Trauma*, 2017, 8(Suppl 1): S11-S16
- [8] Liu HS, Duan SJ, Liu SD, et al. Robot-assisted percutaneous screw placement combined with pelvic internal fixator for minimally invasive treatment of unstable pelvic ring fractures [J]. *Int J Med Robot*, 2018, 14(5): e1927
- [9] Liu HS, Duan SJ, Xin FZ, et al. Robot-assisted Minimally-invasive Internal Fixation of Pelvic Ring Injuries: A Single-center Experience[J]. *Orthop Surg*, 2019, 11(1): 42-51
- [10] McCormick LM, Chen F, Gilbertson J, et al. A biomechanical study comparing minimally invasive anterior pelvic ring fixation techniques to external fixation[J]. *Injury*, 2019, 50(2): 251-255
- [11] Osterhoff G, Aichner EV, Scherer J, et al. Anterior subcutaneous internal fixation of the pelvis - what rod-to-bone distance is anatomically optimal?[J]. *Injury*, 2017, 48(10): 2162-2168
- [12] Rad D, Van Embden D, Bijlsma P, et al. Complex Open Pelvic Fracture in an 8-Year-Old Girl Treated with INFIX-A Case Study[J]. *J Am Acad Orthop Surg Glob Res Rev*, 2019, 3(4): e089
- [13] Reichel LM, McCormick LM, Dugarte AJ, et al. Minimally invasive anterior pelvic internal fixation: An anatomic study comparing Pelvic Bridge to INFIX[J]. *Injury*, 2018, 49(2): 309-314
- [14] Scherer J, Tiziani S, Sprengel K, et al. Subcutaneous internal anterior fixation of pelvis fractures-which configuration of the InFix is clinically optimal?-a retrospective study [J]. *Int Orthop*, 2019, 43(9): 2161-2166
- [15] Shetty AP, Bosco A, Perumal R, et al. Midterm radiologic and functional outcomes of minimally-invasive fixation of unstable pelvic fractures using anterior internal fixator (INFIX) and percutaneous iliosacral screws[J]. *J Clin Orthop Trauma*, 2017, 8(3): 241-248
- [16] Smith A, Malek IA, Lewis J, et al. Vascular occlusion following application of subcutaneous anterior pelvic fixation (INFIX) technique [J]. *J Orthop Surg (Hong Kong)*, 2017, 25(1): e2309499016684994
- [17] Stevens JM, Shiels S, Chessier T. Technique for contouring the cut end of infix bars and external fixator pins [J]. *Ann R Coll Surg Engl*, 2019, 101(6): 438-439
- [18] Stevenson AJ, Swartman B, Bucknill AT. Percutaneous internal fixation of pelvic fractures. German version [J]. *Unfallchirurg*, 2016, 119(10): 825-834
- [19] Stevenson AJ, Swartman B, Bucknill AT. Percutaneous internal fixation of pelvic fractures[J]. *Unfallchirurg*, 2017, 120(Suppl 1): 10-18
- [20] Vaidya R, Martin AJ, Roth M, et al. INFIX versus plating for pelvic fractures with disruption of the symphysis pubis[J]. *Int Orthop*, 2017, 41(8): 1671-1678
- [21] Vaidya R, Martin AJ, Roth M, et al. Midterm Radiographic and Functional Outcomes of the Anterior Subcutaneous Internal Pelvic Fixator (INFIX) for Pelvic Ring Injuries [J]. *J Orthop Trauma*, 2017, 31(5): 252-259
- [22] Vaidya R, Tonnos F, Nasr K, et al. The Anterior Subcutaneous Pelvic Fixator (INFIX) in an Anterior Posterior Compression Type 3 Pelvic Fracture[J]. *J Orthop Trauma*, 2016, 30(2): S21-S22
- [23] Wu XT, Liu ZQ, Fu WQ, et al. Minimally invasive treatment of unstable pelvic ring injuries with modified pedicle screw-rod fixator[J]. *J Int Med Res*, 2018, 46(1): 368-380
- [24] Yin Y, Luo J, Zhang R, et al. Anterior subcutaneous internal fixator (INFIX) versus plate fixation for pelvic anterior ring fracture [J]. *Sci Rep*, 2019, 9(1): e2578
- [25] Müller FJ, Stosiek W, Zellner M, et al. The anterior subcutaneous internal fixator (ASIF) for unstable pelvic ring fractures: clinical and radiological midterm results[J]. *Int Orthop*, 2013, 37(11): 2239-2245
- [26] Kim MW, Chung YY, Lim SA, et al. Selecting Arthroplasty Fixation Approach Based on Greater Trochanter Fracture Type in Unstable Intertrochanteric Fractures[J]. *Hip Pelvis*, 2019, 31(3): 144-149
- [27] Li L, Lu J, Yang L, et al. Stability evaluation of anterior external fixation in patient with unstable pelvic ring fracture: a finite element analysis[J]. *Ann Transl Med*, 2019, 7(14): e303
- [28] Li P, Zhou D, Fu B, et al. Management and outcome of pelvic fracture associated with vaginal injuries: a retrospective study of 25 cases [J]. *BMC Musculoskelet Disord*, 2019, 20(1): e466
- [29] Becker CA, Kammerlander C, Kussmaul AC, et al. Modified less-invasive anterior subcutaneous fixator for unstable Tile-C-pelvic ring fractures: a biomechanical study[J]. *Biomed Eng Online*, 2019, 18(1): 38-46
- [30] Fang C, Alabdulrahman H, Pape HC. Complications after percutaneous internal fixator for anterior pelvic ring injuries [J]. *Int Orthop*, 2017, 41(9): 1785-1790
- [31] Hoskins W, Bucknill A, Wong J, et al. A prospective case series for a minimally invasive internal fixation device for anterior pelvic ring fractures[J]. *J Orthop Surg Res*, 2016, 11(1): 135-147