

doi: 10.13241/j.cnki.pmb.2018.10.035

复合负压吸引的外固定钢板治疗四肢开放性骨折的应用价值*

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摘要 目的:探讨复合负压吸引的外固定钢板治疗四肢开放性骨折的应用价值。**方法:**选择2014年1月到2017年1月到我院诊治的胫腓骨中下段开放性骨折患者共68例为研究对象,根据随机信封抽签原则分为观察组与对照组,每组34例。对照组给予负压封闭引流(vacuum sealing drainage, VSD)的常规外固定钢板治疗,观察组给予复合负压吸引的外固定钢板治疗,记录和比较围手术期严重并发症的发生情况、手术时间、骨折愈合时间、临床疗效和创口愈合情况。**结果:**两组患者都完成手术,围手术期并无严重并发症发生。观察组的手术时间与骨折愈合时间分别为 38.24 ± 8.16 min和 8.83 ± 1.01 周,均明显少于对照组(49.50 ± 9.87 min和 12.23 ± 0.91 周)($P < 0.05$)。术后3个月,观察组和对照组的疗效优良率分别是97.1%、82.4%,观察组明显高于对照组($P < 0.05$);观察组的创口甲级愈合28例,乙级愈合6例,丙级愈合0例;对照组甲级愈合21例,乙级愈合8例,丙级愈合5例,观察组创口愈合情况明显优于对照组($P < 0.05$)。**结论:**复合负压吸引的外固定钢板治疗四肢开放性骨折能明显缩短手术时间,促进骨折愈合,提高创口愈合质量,提高临床疗效。

关键词:复合负压吸引;负压封闭引流;外固定钢板;四肢开放性骨折;愈合质量

中图分类号:R683.4 **文献标识码:**A **文章编号:**1673-6273(2018)10-1973-04

Application Value of Compound Vacuum Suction External Fixation Plate for the Open Fracture of Limbs*

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ABSTRACT Objective: To investigate the clinical value of compound vacuum suction external fixation plate for the treatment of open fracture of limbs. **Methods:** From January 2014 to January 2017, 68 cases of patients with open fracture of tibia and fibula treated in our hospital were selected as the research object and divided into the observation group and the control group with 34 cases in each group according to the random lottery envelopes. The control group was treated with vacuum sealing drainage(VSD) conventional external fixation plate treatment, the observation group was given compound vacuum suction external fixation plate treatment, the the incidence of severe complications during perioperative period, operation time, fracture healing time, clinical efficacy and wound healing were recorded and compared between two groups. **Results:** All the patients in both groups completed the surgery and there was no serious complications during the perioperative period, the operation time, fracture healing time in the observation group were 38.24 ± 8.16 min and 8.83 ± 1.01 weeks, which were significantly less than those of the control group (49.50 ± 9.87 min and 12.23 ± 0.91 weeks)($P < 0.05$). The excellent and good rate of observation group and control group at 3 months postoperation were 97.1% and 82.4%, respectively, which was significantly higher in the observation group than that of the control group ($P < 0.05$). The quality of wound healing at 3 months postoperation in the observation group showed 28 cases of Class A healing and 6 cases of Class B healing, which were 21 cases of Class A healing, 8 cases of Class B healing and 5 cases of Class C healing in the control group, the wound healing of observation group was better than that of the control group ($P < 0.05$). **Conclusion:** Compound vacuum suction external fixation plate could obviously shorten the operation time, improve the fracture healing and the quality of wound healing for the treatment of open fracture of limbs.

Key words: Compound vacuum suction; Vacuum sealing drainage; External fixation plate; Open fracture of limbs; Healing quality

Chinese Library Classification(CLC): R683.4 **Document code:** A

Article ID: 1673-6273(2018)10-1973-04

前言

机械挤压伤、车祸伤等高能损伤会导致四肢损伤,其常常

合并严重的软组织缺损、碾挫、骨外露。四肢开放性骨折是骨科临床最常见也是治疗效果最不肯定的病症,此种骨折损伤重,骨折直接与外界暴露,感染几率高,骨髓炎形成几率高。临床对

* 基金项目:陕西省卫生科研基金项目(2016D077)

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(收稿日期:2017-10-09 接受日期:2017-10-31)

于四肢开放性骨折合并严重软组织缺损创面的早期处理主要包括一期清创闭合创面,换药二期闭合创面,且需要二次或多次手术治疗,病程长,患者费用高,后遗症较多,可能出现继发创面感染、深部引流不畅,治疗费用高^[1-4]。

在开放性骨折的常规治疗中,清创固定负压封闭引流(vacuum sealing drainage, VSD)比较常见,但传统的固定方式为外固定支架,安装相对复杂,尤其是贴附 VSD 材料困难,术后患肢穿衣困难,在寒冷地区尤其是北方容易发生冻疮等并发症^[5-8]。针对四肢开放性骨折,已有研究从生物力学、医学材料学、实验室及临床多个角度设计研制治疗四肢开放性骨折使用的复合负压吸引材料的外固定钢板,经实验室验证逐步进行改进,具有使用简单、固定效果可靠、感染率低等优点^[9-11]。本研究探讨了在治疗四肢开放性骨折中应用复合负压吸引的外固定

钢板的临床价值,报道如下。

1 资料与方法

1.1 一般资料

选择 2014 年 1 月至 2017 年 1 月在我院诊治的胫腓骨中下段开放性骨折的患者共计 68 例作为研究对象,纳入标准:经 CT 影像学检查或 X 线检查诊断为胫腓骨中下段开放性骨折,在术中得到确诊;年龄 20-80 岁,具备手术适应证;新鲜开放性骨折;伤后 1-12 h 内入院治疗;患者知情同意本研究且得到医院伦理委员会的批准。根据随机信封抽签原则分为观察组与对照组,每组各 34 例。两组患者的性别、年龄、致伤原因、骨折 Gustilo 分型、伤后入院时间等对比差异均无统计学意义($P>0.05$),具有可比性。见表 1。

表 1 两组一般资料的对比

Table 1 Comparison of the general data between two groups

Groups	Amount(n)	Gender (male/female)	Age(year)	Cause of injury (traffic injury / falling at high altitude / heavy injury / fight the injury)	Fracture classification (I/II/III)	Admission time after injury(h)
Observation group	34	18/16	39.53± 7.34	11/12/8/3	12/18/4	6.33± 1.92
Control group	34	17/17	39.11± 6.38	12/13/6/4	11/16/7	6.29± 1.44
P		>0.05	>0.05	>0.05	>0.05	>0.05

1.2 治疗方法

术前准备:对脱水、休克及出血等危及生命的创伤进行对症处理,术前 1 h 进行术前抗感染,待患者生命体征基本恢复平稳后行手术治疗。

手术方法:选用硬膜外麻醉或腰麻,彻底清创并反复清洗,对骨膜及血供较好的软组织进行保护。清创完成后初步复位骨折部位,如果伤口累及腓骨,且难于固定腓骨或腓骨不固定难于建立胫骨长度,需对腓骨进行固定(行腓骨切开复位并用钢板、克氏针进行内固定,于胫骨远端外侧做 2~4 cm 直切口,对胫骨骨折断端进行复位并固定)。对照组安放 VSD 的常规外固定钢板,对观察组安放复合负压吸引的外固定钢板,在胫骨远端踝关节面上方的平行关节面插入 2 枚直径为 4 mm 骨圆针,将 4 枚直径为 4 mm 骨圆针垂直于胫骨干平行穿入并进行固定,进行适当的固定夹加压固定,为方便换药及安置 VSD 引流管,外固定针进针点要避开骨折线及软组织损伤部位,然后以 VSD 材料封闭创面,持续负压吸引,然后安装外固定钢板,使用 VSD 负压吸引。

术后处理:进行术后抗感染处理,循序渐进进行肌肉舒缩锻炼、患肢踝关节主动、被动活动等。

1.3 疗效评价

(1)疗效评定:优:健侧与患肢等长,X 线显示骨折解剖复位或成角 $<5^\circ$,踝关节、膝关节功能恢复正常者;良:患肢比健侧短 1 cm 内,X 线显示骨折断端存在侧方移位,移位范围发生在骨折面 25%以内,且成角 $<10^\circ$,踝关节、膝关节功能恢复较好者;可:患肢比健侧缩短 1-2 cm,X 线显示成角 $<15^\circ$,踝关节、膝关节功能恢复一般并存在一定功能障碍者;差:无达到上述标准甚或恶化者。(2)记录两组创口愈合情况,包括甲级、乙级与丙级愈合。(3)记录两组手术时间与骨折愈合时间。

1.4 统计学处理

使用 SPSS 20.0 数据分析软件对所测数据进行统计学分析,计数数据用($\bar{x} \pm s$)表示,计数数据采用%表示,组间比较分别采用 t 检验与 χ^2 检验,以 $P<0.05$ 为差异具有统计学意义的标准。

2 结果

2.1 两组手术时间与骨折愈合时间的对比

两组患者都完成手术,围手术期均无严重并发症发生。观察组的手术时间与骨折愈合时间分别为 38.24 ± 8.16 min 和 8.83 ± 1.01 周,都明显少于对照组(49.50 ± 9.87 min 和 12.23 ± 0.91 周)($P<0.05$),见表 2。

表 2 两组手术时间与骨折愈合时间对比($\bar{x} \pm s$)

Table 2 Comparison of the operation time and fracture healing time between two groups($\bar{x} \pm s$)

Groups	Amount(n)	Operation time(min)	Fracture healing time(week)
Observation group	34	38.24± 8.16	8.83± 1.01
Control group	34	49.50± 9.87	12.23± 0.91
P		<0.05	<0.05

2.2 两组疗效优良率的对比

照组(82.4%, $P < 0.05$)。见表 3。

术后 3 个月, 观察组的疗效优良率是 97.1%, 显著高于对

表 3 两组疗效优良率的对比(n)

Table 3 Comparison of the excellent rate between two groups(n)

Groups	Amount(n)	Excellent	Good	Moderate	Poor	Excellent rate
Observation group	34	30	3	1	0	97.1%
Control group	34	18	10	5	1	82.4%
P						<0.05

2.3 两组创口愈合情况的对比

愈合 5 例, 观察组的创口甲级愈合显著高于对照组, 差异有统计学意义($P < 0.05$), 见表 4。

术后 3 个月, 观察组的创口甲级愈合 28 例, 乙级愈合 6 例, 丙级愈合 0 例; 对照组甲级愈合 21 例, 乙级愈合 8 例, 丙级

表 4 两组术后创口愈合情况对比[例(%)]

Table 4 Comparison of the wound healing after operation between two groups[n(%)]

Groups	Amount(n)	Class A healing	Class B healing	Class C healing
Observation group	34	28(82.4%)	6(17.6%)	0(0.0%)
Control group	34	21(61.8%)	8(23.5%)	5(14.7%)
P		<0.05	>0.05	<0.05

3 讨论

四肢开放性骨折是骨科临床最常见也是治疗效果最不肯定的病症, 其中胫腓骨中下段开放性骨折由于骨折伴有软组织损伤或严重挫裂撕脱伤, 骨折直接与外界暴露, 感染几率高, 骨髓炎形成几率高, 需要多次手术治疗, 因而治疗后遗症比较多, 患者费用高, 一直是骨科研究的重点^[12-15]。

清创固定 VSD 负压吸引已经成为开放性骨折的常规治疗方法, 但传统的固定方式为外固定支架, 安装相对复杂, 尤其是贴附 VSD 负压吸引材料困难, 术后 VSD 容易渗漏破裂导致封闭性受损, 直接影响软组织修复及预防感染效果^[16-19]。本研究采用的复合负压吸引的外固定钢板能密闭良好的创面, 形成并维持 125 mmHg 左右的负压, 使得创面很快获得清洁的环境, 减少创面细菌的数量, 防止感染扩散。本研究结果显示两组都完成手术, 围手术期无严重并发症发生, 观察组的手术时间与骨折愈合时间都明显短于对照组, 表明复合负压吸引的外固定钢板能缩短手术时间, 促进骨折愈合。

四肢骨折中最容易出现的骨折包括胫腓骨中下段开放性骨折, 此类骨折的诱因主要是高能损伤, 且中下 1/3 骨血液供应较差, 若不能得到及时有效的治疗, 易出现骨折愈合困难等情况, 严重影响患侧肢体功能^[20-24]。VSD 利用高分子泡沫材料作为负压引流管和创面间的中介, 引流通畅, 对常规传统换药和引流所造成的污染、感染可进行有效的预防, 但应用的持续效果不佳^[25,26]。近年来, 对于开放性骨折选用锁定钢板外置逐渐初露头角, 形成一种崭新的对于开放性骨折的治疗方法和思路。有研究显示外固定钢板有骨折固定更可靠、愈合更快, 不增加术后并发症等其不可替代的优势, 特别是锁钉钢板外置固定骨折在生物力学性能上优于外固定支架^[27,28]。研究结果显示术

后 3 个月观察组的疗效优良率是 97.1%, 显著高于对照组, 表明复合负压吸引的外固定钢板不仅可实现有效的骨折固定, 还能进一步保护骨折周围血供, 改善预后。

胫骨拥有独特的解剖特点、血供情况, 下段骨折时常导致胫骨营养血管的损伤, 以致骨折断端的愈合延迟, 甚至可能造成不愈合的状况^[29]。本研究选用锁定外置钢板, 将临床上面对软组织损伤使用的负压吸引材料进行考虑, 将二者结合于一体, 既能固定骨折, 同时也能处理软组织损伤, 设计研制治疗四肢开放性骨折使用的复合负压吸引材料的外固定钢板^[30,31]。本研究结果显示观察组的创口甲级愈合显著高于对照组, 也表明复合负压吸引的外固定钢板的应用能提高创口愈合质量。

总之, 复合负压吸引的外固定钢板治疗四肢开放性骨折能明显缩短手术时间, 促进骨折愈合, 提高创口愈合质量, 提高临床疗效。

参考文献(References)

- [1] Ebersbach J, Muellner-Riehl A N, Michalak I, et al. In and out of the Qinghai-Tibet Plateau: divergence time estimation and historical biogeography of the large arctic-alpine genus *Saxifraga* L. [J]. *Journal of Biogeography*, 2017, 44(4): 900-910
- [2] Zhao S P, Nan Z T, Huang Y B, et al. The Application and Evaluation of Simple Permafrost Distribution Models on the Qinghai-Tibet Plateau[J]. *Permafrost & Periglacial Processes*, 2017, 28(2): 41-43
- [3] Tu X, Li Z, Zhang Z, et al. The Potential Geographical Distribution of *Locusta Migratoria Tibetensis* Chen (Orthoptera: Acrididae) in Qinghai-Tibet Plateau [C]// *Computer and Computing Technologies in Agriculture VI*, 2016: 343-351
- [4] Wu J, Duan D, Lu J, et al. Inorganic pollution around the Qinghai-Tibet Plateau: An overview of the current observations [J]. *Science of the Total Environment*, 2016, 550(6): 628-636

- [5] Chouhan V. Qivas Therapy for Treatment of Implant Associated MDR Bacterial Infection[J]. J Orthop Case Rep, 2016, 6(2): 69-71
- [6] Penner K, Manji K, Wedel M, et al. Ankle syndesmotic fixation using two screws: risk of injury to the perforating branch of the peroneal artery[J]. J Foot Ankle Surg, 2014, 53(5): 534-538
- [7] Kliushin N M, Ababkov Y V, Ermakov A M, et al. Modified Girdlestone arthroplasty and hip arthrodesis using the Ilizarov external fixator as a salvage method in the management of severely infected total hip replacement [J]. Indian Journal of Orthopaedics, 2016, 50 (1): 16-24
- [8] Sporns PB, Zimmer S, Hanning U, et al. Acute tonsillar cerebellar herniation in a patient with traumatic dural tear and VAC therapy after complex trauma[J]. Spine J, 2015, 15(7): 13-16
- [9] Defazio L V, Laporta G A. Minimally-Invasive Repair of Bilateral Calcaneal Fractures with Unilateral External Fixation: A Case Report[J]. Journal of the American Podiatric Medical Association, 2016, 106 (sp1): 9
- [10] Roy A C, Albert S, Gouse M, et al. Functional outcome of knee arthrodesis with a monorail external fixator [J]. Strategies in Trauma & Limb Reconstruction, 2016, 11(1): 31-35
- [11] Hardeski D, Gaski G, Joshi M, et al. Can applied external fixators be sterilized for surgery? A prospective cohort study of orthopaedic trauma patients[J]. Injury-international Journal of the Care of the Injured, 2016, 47(12): 2679
- [12] Kizilay Z, Yilmaz A, Ismailoglu O. Symptomatic pneumocephalus after lumbar disc surgery: a case report[J]. Open Access Maced J Med Sci, 2015, 3(1): 143-145
- [13] Wennberg O P, Casini G, Jonoud S, et al. The characteristics of open fractures in carbonate reservoirs and their impact on fluid flow: a discussion[J]. Petroleum Geoscience, 2016, 22(1): 91-104
- [14] Wordsworth M, Lawton G, Nathwani D, et al. Improving the care of patients with severe open fractures of the tibia: the effect of the introduction of Major Trauma Networks and national guidelines [J]. Bone Joint J, 2016, 98-B(3): 420-424
- [15] Bonneville P. Operative treatment of early infection after internal fixation of limb fractures (exclusive of severe open fractures)[J]. Orthopaedics & Traumatology Surgery & Research, 2017, 103(1S): S67
- [16] Osamura N, Ikeda K, Matsubara H. Posterior approach using a proximal humeral internal locking system long plate for open fractures of the distal tibia: A report of three cases[J]. Journal of Orthopaedic Science, 2016, 21(4): 552-556
- [17] Rosalba O P, Cordeiro C V, Da S F C, et al. The incidence and microbiological profile of surgical site infections following internal fixation of closed and open fractures [J]. Revista Brasileira De Ortopedia, 2016, 51(4): 396-399
- [18] Ying-Chao C, Cheng Y S, Yung-Heng H, et al. A bio-artificial poly (d,l)-lactide-co-glycolide drug-eluting nanofibrous periosteum for segmental long bone open fractures with significant periosteal stripping injuries [J]. International Journal of Nanomedicine, 2016, 11(3): 941-953
- [19] Tulipan J E, Ilyas A M. Open Fractures of the Hand: Review of Pathogenesis and Introduction of a New Classification System[J]. Orthopedic Clinics of North America, 2016, 47(1): 245
- [20] Zhu J, Yu A, Qi B, et al. Effects of negative pressure wound therapy on mesenchymal stem cells proliferation and osteogenic differentiation in a fibrin matrix[J]. PLoS One, 2014, 9(9): e107339
- [21] Lee KM, Choi SH, Lee JH. Usefulness of a negative suction drain for reducing postoperative swelling in a blowout fracture[J]. J Oral Maxillofac Surg, 2014, 72(8): 1545-1551
- [22] Gill S P, Raj M, Kumar S, et al. Early Conversion of External Fixation to Interlocked Nailing in Open Fractures of Both Bone Leg Assisted with Vacuum Closure (VAC) - Final Outcome[J]. J Clin Diagn Res, 2016, 10(2): RC10-RC14
- [23] Laffosse J, Iglesias K, Grare M, et al. Treatment of open fractures of the tibia with locked intramedullary nail with a core release of antibiotics (SAFE DualCore Universal). Comparative study with standard locked intramedullary nail [J]. Revue De Chirurgie Orthopedique Et Traumatologique, 2016, 102(7): S112-S112
- [24] Gogulescu B. OS7-53 Multiplanar external fixation in tibia open fractures (by using a couple of external fixators)[J]. Injury-international Journal of the Care of the Injured, 2016, 47(5): S21-S21
- [25] Inomata K, Costa M, Föhringer S. Development of a prototype to support the lower limb during the antiseptics of open fractures [J]. Revista De Enfermagem Referência, 2016, IV Série(11): 133-138
- [26] Muñoz M, Iglesias D, Garcia-Erce JA, et al. Utility and cost of low-vacuum reinfusion drains in patients undergoing surgery for subcapital hip fracture repair. A before and after cohort study [J]. Vox Sang, 2014, 106(1): 83-91
- [27] Hayashi A, Matsuda N, Horiguchi M, et al. Cylinder syringe suction: a simple and efficient technique for the evacuation of subcutaneous hematoma[J]. J Craniofac Surg, 2013, 24(3): 777-780
- [28] Tripathy S P, Zuber M, Gautam A, et al. Results of non-microvascular flap cover surgery for management of soft tissue injury in open fractures of leg bones [J]. Iosr Journal of Dental & Medical Sciences, 2016, 15(10): 56-61
- [29] Ramlee MH, Kadir MR, Murali MR, et al. Finite element analysis of three commonly used external fixation devices for treating Type III pilon fractures[J]. Med Eng Phys, 2014, 36(10): 1322-1330
- [30] Fochtmann A, Binder H, Rettl G, et al. Third degree open fractures and traumatic sub-/total amputations of the upper extremity: Outcome and relevance of the Mangled Extremity Severity Score [J]. Orthopaedics & Traumatology Surgery & Research, 2016, 102 (6): 785-790
- [31] Estill KM, Quevedo GL, Bonifacio LR. Improvised suction apparatus for closure of large soft tissue deficit[J]. Malays Orthop J, 2013, 7(2): 29-33