doi:10.11659/jjssx03E023024

·临床研究·

桡动脉茎突返支蒂桡骨茎突骨(膜)瓣治疗腕舟状骨骨折的解剖基础与临床效果

雷鹏程[1],方志辉[1],陶圣祥[2],周寅寅[3] (1.湖北医药学院附属国药东风总医院急救医学部,湖北 十堰 442000;2.武汉大学中南医院骨外科,湖北 武汉 430062;3.湖北医药学院附属国药东风总医院信息统计中心,湖北 十堰 442000)

[摘 要] **目的** 探讨桡动脉茎突返支蒂桡骨茎突骨(膜)瓣修复腕舟状骨骨折的解剖学基础及临床效果。**方法** 测量25例成人桡骨标本桡骨茎突的等位长度;解剖1具乳胶灌注男性成人上肢标本,观察桡动脉茎突返支的走行及分布。回顾性分析15例以桡动脉茎突返支为蒂行桡骨茎突骨(膜)瓣转位植入修复腕舟状骨骨折患者的临床资料,分析其治疗效果。**结果** 25例桡骨标本测量结果显示,桡骨茎突长11~16 mm。解剖乳胶灌注男性成人上肢标本发现:在鼻烟窝内的桡动脉于茎突下方(1.2±0.2)cm处向尺侧发出1支较粗的腕背支,再向近端发出返回茎突部的分支。15例患者术后骨折线消失,骨折愈合率100%,平均愈合时间为12周;Krimmer腕关节功能评分显示,优6例,良7例,可2例,优良率为86.7%;患者术后疼痛视觉模拟量表评分低于术前,差异具有统计学意义($P<0.05$)。**结论** 通过测量实物标本桡骨茎突,观察成人上肢标本桡动脉茎突返支的走行及分布情况,可以指导临床治疗腕舟状骨骨折手术方案的制定。桡动脉茎突返支蒂桡骨茎突骨(膜)瓣转位植入治疗腕舟状骨骨折可以有效促进骨折愈合,降低延迟愈合风险,术后腕关节功能恢复良好,临床效果确切。

[关键词] 腕舟状骨;骨折;桡骨茎突骨瓣转位;桡动脉茎突返支;解剖
[中图分类号] R683.41 [文献标志码] A [收稿日期] 2023-03-06

Anatomical basis and clinical effect of radical styloid process bone (membrance) flap pedicled with the recurrent branch of radial artery to styloid process in the treatment of carpal scaphoid fracture

LEI Peng-cheng[1], FANG Zhi-hui[1], TAO Sheng-xiang[2], ZHOU Yin-yin[3] (1. Department of Emergency Medicine, Sinopharm Dongfeng General Hospital Affiliated to Hubei University of Medicine, Shiyan Hubei 442000, China; 2. Department of Orthopaedic Surgery, Central South Hospital of Wuhan University, Wuhan Hubei 430062, China; 3. Information Statistical Center, Sinopharm Dongfeng General Hospital Affiliated to Hubei University of Medicine, Shiyan Hubei 442000, China)

Abstract: Objective To explore the anatomical basis and clinical effect of radical styloid process bone (membrance) flap pedicled

[基金项目] 十堰市引导性项目(18Y94)
[通信作者] 方志辉,E-mail:25910033@qq.com

[12] Viderman D, Tapinova K, Abdildin YG. Mechanisms of cerebral vasospasm and cerebral ischaemia in subarachnoid haemorrhage[J]. Clin Physiol Funct Imaging, 2023, 43(1): 1-9. doi: 10.1111/cpf.12787.
[13] Romenskaya T, Longhitano Y, Piccolella F, et al. Cerebralvasospasm: practical review of diagnosis and management[J]. Rev Recent Clin Trials, 2023, 18(1): 12-18. doi: 10.2174/1574887117666220810121048.
[14] 尹 航,冯丽君,肖龙海,等.血清可溶性细胞间黏附分子1,半胱氨酸天冬氨酸蛋白水解酶3水平对颅内破裂动脉瘤术后脑血管痉挛的预测价值[J].中国医药导报,2021,18(14):67-71.
[15] Huang X, Jia L, Jia Y, et al. sFlt-1-enriched exosomes induced endothelial cell dysfunction and a preeclampsia-like phenotype in mice[J]. Cytokine, 2023, 166(1): 1-8. doi: 10.1016/j.cyto.2023.156190.
[16] Liao L, Zhao X, Zhou M, et al. sFlt-1: a double regulator in angiogenesis-related diseases[J]. Curr Pharm Des, 2021, 27(40): 4160-4170. doi: 10.2174/1381612827666210902155015.
[17] 吴文彬.颅脑损伤后外周血HIF-1α,SICAM-1及sFlt-1表达水平与发生脑血管痉挛的关系研究[J].医学理论与实践,2023,36(11):1808-1811. doi:10.19381/j.issn.1001-7585.2023.11.003.
[18] 吕 霞,周小燕,焦黛妍.血清sCAM-1,IGF-1和sFlt-1对自发性蛛网膜下腔出血后脑血管痉挛的病情与预后评估的价值[J].河北医药,2022,44(8):1194-1197. doi:10.3969/j.issn.1002-7386.2022.08.017.
[19] Hijioka M, Futokoro R, Ohto-Nakanishi T, et al. Microglia-released leukotriene B4 promotes neutrophil infiltration and microglial activation following intracerebral hemorrhage[J]. Int Immunopharmacol, 2020, 85(1): 1-13. doi: 10.1016/j.intimp.2020.106678.
[20] Futokoro R, Hijioka M, Arata M, et al. Lipoxin A4 receptor stimulation attenuates neuroinflammation in a mouse model of intracerebral hemorrhage[J]. Brain Sci, 2022, 12(2): 162-175. doi: 10.3390/brainsci12020162.
[21] Chan SJ, Ng MPE, Zhao H, et al. Early and sustained increases in leukotriene b4 levels are associated with poor clinical outcome in ischemic stroke patients[J]. Neurotherapeutics, 2020, 17(1): 282-293. doi: 10.1007/s13311-019-00787-4.
[22] Hao J, Feng Y, Xu X, et al. Plasma lipid mediators associate with clinical outcome after successful endovascular thrombectomy in patients with acute ischemic stroke[J]. Front Immunol, 2022, 13(1): 1-13. doi: 10.3389/fimmu.2022.917974.

(编辑:贺绍梅)

with the recurrent branch of radial artery to styloid process for repairing carpal scaphoid fracture. **Methods** The equal lengths of the radial styloid process in 25 adult radial specimens were measured. A latex-perfused male adult upper limb specimen was dissected to observe the course and distribution of the recurrent branch of radial artery to styloid process. The clinical data of 15 patients with carpal scaphoid fracture repaired by transposition and implantation of radical styloid process bone (membrance) flap pedicled with the recurrent branch of radial artery to styloid process were retrospectively analyzed, and the therapeutic effect was analyzed. **Results** The length of the radial styloid process measured on 25 radial specimens was 11 to 16 mm. Dissection of the latex-perfused male adult upper limb specimens revealed: the radial artery in the snuffbox emitted a thicker dorsal carpal branch to the ulnar side at (1.2±0.2) cm below the styloid process, and then sent a branch proximally back to the styloid process. The fracture line of 15 patients disappeared after surgery, with a fracture healing rate of 100%, and a mean healing time of 12 weeks; the Krimmer wrist joint function score showed that 6 cases were excellent, 7 cases were good, and 2 cases were acceptable, with excellent and good rate of 86.7%; patients had lower postoperative pain visual analogue scale scores compared with those before surgery, the difference was significant ($P<0.05$). **Conclusion** Measuring the radial styloid process of the physical specimen and observing the course and distribution of the recurrent branch of radial artery to styloid process in adult upper limb specimens can guide the formulation of surgical plan for the treatment of carpal scaphoid fractures in clinic. The transposition and implantation of radical styloid process bone (membrance) flap pedicled with the recurrent branch of radial artery to styloid process can effectively promote fracture healing, and reduce the risk of delayed healing, which has good postoperative recovery of wrist joint function and definite clinical effect in the treatment of carpal scaphoid fractures.

Keywords: carpal scaphoid; fracture; transposition of radial styloid process bone flap; recurrent branch of radial artery to styloid proces; anatomy

腕舟状骨作为头状骨与月骨间的桥梁,起到连接、传导应力和稳定腕关节的作用,腕舟状骨骨折的发生率在上肢骨折中仅次于桡骨远端骨折[1]。而腕舟状骨腰部骨折约占舟骨骨折的80%,近端和远端骨折分别占15%和5%,多为不完全性骨折[2-6]。腕舟状骨骨折治疗方法较多,包括保守治疗(石膏外固定)及手术干预等,但临床疗效不尽相同。因腕舟状骨独特的逆行供血结构,即便是新鲜无移位骨折,术后骨折不愈合率也高达15%[7-10]。王雪梅等[11]报道,带血管蒂桡骨骨膜瓣移植可治疗腕舟状骨骨折。此后,使用桡动脉茎突返支蒂桡骨茎突骨(膜)瓣治疗腕舟状骨骨折逐渐受到临床的重视。但以往对于桡骨茎突的形态学特点了解不足,使得临床治疗效果并不十分理想,有待进一步研究。本研究通过测量桡骨茎突实物标本,观察成人上肢标本桡动脉茎突返支的走行及分布情况,以指导腕舟状骨骨折的临床治疗,并采用桡动脉茎突返支蒂桡骨茎突骨(膜)瓣联合内固定治疗合并骨不连风险的A2型、B型及D2型腕舟状骨骨折,取得了良好临床疗效,现报道如下。

1 资料与方法

1.1 标本来源

25例成人桡骨标本,男15例,女10例;左12例,右13例,测量桡骨茎突的长度。乳胶灌注男性成人上肢标本1具,解剖并观察桡动脉茎突返支的走行及分布情况。标本均由武汉大学医学部解剖学教研室提供。

1.2 临床资料

回顾性分析武汉大学中南医院2015年1月至2020年12月15例男性腕舟状骨骨折患者的资料,患者行以桡动脉茎突返支为蒂的桡骨茎突骨(膜)瓣转位内固定;年龄18~40岁,平均(24.33±6.06)岁;骨折情况:9例为新鲜骨折,6例为陈旧性骨折;受伤至手术时间3 d至2年;改良Herbert分型:A2型7例,B2型4例,B3型2例,D2型2例。

1.3 手术方法

患者采用臂丛神经阻滞麻醉,取仰卧位,患肢置于高度合适平面,上臂上气囊止血带。解剖鼻烟窝纵轴做1个S形切口划线,向两侧游离皮瓣,远端达腕舟状骨结节。分离头静脉、桡神经浅支及拇长展肌腱,显露桡动脉及桡骨茎突,在桡骨茎突背侧骨膜上仔细辨认茎突返支血管,并沿茎突返支血管逆行找到蒂部,然后予以保护。按预先设计,在桡骨茎突上用骨凿凿取一长1.2 cm、宽0.6 cm、厚0.5 cm的骨瓣,适当向远侧掀起,查看蒂长度,若不能到达腕舟状骨骨折端,则需继续游离,尽量将茎突返支连同周围筋膜一起分离,注意动作轻柔,保护骨瓣,避免骨膜剥脱及蒂部牵拉。松止血带,观察桡骨茎突返支骨瓣断端血运。取湿润的盐水纱布覆盖茎突返支骨瓣予以保护,取骨科专用器械在腕舟状骨上开槽,同时清除骨折间隙嵌入的软组织,修整骨瓣大小,充分保留骨瓣上的筋膜,然后嵌入骨槽内,确保松紧度合适。将骨瓣附着的软组织与腕关节囊妥善缝合固定,术中根据实际

情况使用交叉克氏针或空心加压螺钉固定腕舟状骨骨折端及骨瓣,C型臂X射线透视见骨瓣位置满意后,修剪克氏针尾端至合适长度,并置于皮下较浅位置,关闭切口。

术后常规抗感染治疗,拇指人字石膏托外固定腕关节。术后第2天开始进行掌指关节及各指间关节的被动活动;术后2周拆线;术后4~6周根据病情拆除克氏针和石膏托,并进行限制性的腕关节主动功能锻炼。

1.4 观察指标

术后随访24~36个月,术后6个月内每月复查腕关节X射线正侧位片及腕舟状骨轴位片,之后每2~3个月复查X射线至骨折愈合。术后6个月采用Krimmer评分[8]评价腕关节功能,其中80分以上为优,66~80分为良,50~65分为可,50分以下为差。术前及术后6个月采用视觉模拟量表(visual analogue scale, VAS)评价腕关节疼痛情况。

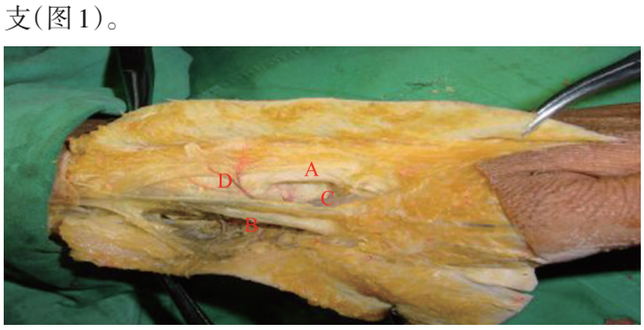
1.5 统计学处理

采用SPSS 16.0软件进行统计学分析。计量资料以均数±标准差($\bar{x}\pm s$)表示,不同时间点的比较采用配对t检验。以P<0.05为差异有统计学意义。

2 结果

2.1 桡骨茎突的骨性结构和血供

25例桡骨标本中测得桡骨茎突的长度为11~16 mm。解剖乳胶灌注男性成人上肢标本发现:在鼻烟窝内的桡动脉于茎突下方(1.2±0.2)cm处向尺侧发出1支较粗的腕背支,再向近端发出返回茎突部的分支(图1)。



A:拇长伸肌腱;B:拇长展及拇短伸肌腱;C:桡动脉腕背支;D:桡动脉茎突返支

图1 桡动脉茎突返支的走行及分布

2.2 腕关节功能及疼痛评分

15例患者术后经石膏外固定4~6周后,骨折线消失;骨折平均愈合时间12周,愈合率100%;Krimmer腕关节功能评分显示,术后6个月患者疗效优6例,良7例,可2例,优良率为86.7%。患者术后VAS评分为(2.40±2.49)分,低于术前的(5.80±3.01)分,差异有统计学意义(P=0.002)。

3 讨论

腕舟状骨骨折早期治疗不当,容易造成骨折愈合困难、缺血坏死等严重并发症,故在治疗前应对骨折进行准确分型。Herbert分型是现阶段临床最为常用的分型方法,A型和B型均属于新鲜骨折,其中A型为稳定性骨折,B型为不稳定性骨折;C型和D型则属于陈旧性骨折,其中C型为腕舟状骨延迟愈合,D型为骨不连。对于A型和B型患者,以往多采取保守治疗,部分不稳定性骨折需进行开放手术。保守治疗方式以手法复位、石膏或小夹板固定等为主,但该方法对于腕舟状骨近端骨折和移位超过1 mm的不稳定性骨折效果不理想[10,12]。其他类型的腕舟状骨骨折则以手术为主,包括克氏针、螺钉、钢板、Russe植骨术、联合应用游离植骨或带血管蒂的骨瓣植骨等,均可获得较好的治疗效果。随着手术技术的不断发展,已有学者将开放复位内固定手术的适应证扩大到A型稳定性骨折[13]。值得注意的是,传统的游离植骨主要依靠成骨细胞的爬行替代过程在骨折端成骨,愈合较慢,且骨不连发生率仍较高。随着显微骨移植理念的发展,带血供植骨修复四肢骨不连及骨缺损的方法逐渐成熟。带血供植骨修复不仅能为骨折端成骨提供支架,其丰富的血供还可为骨折端提供多种成骨细胞,促进坏死骨的血管化,更易成骨。

有报道显示,带血供骨瓣植入后,能使原本已缺血坏死的腕舟状骨近端的骨折块恢复血运[14-16],从而促进骨折的愈合。有学者纳入5 246例腕舟状骨骨折患者进行分析,结果显示,带血供植骨能促进腕舟状骨骨折愈合,并降低骨不连发生率[17]。随着临床应用解剖学研究的发展,带蒂骨瓣转位移植修复腕舟状骨骨折具有较好的应用前景。目前,带蒂骨瓣移植有多种方式,如以旋前方肌为蒂的骨瓣移植、以1、2伸肌室间支持带上动脉为蒂的桡骨骨瓣移植、桡动脉腕背支掌骨瓣移植、桡动脉腕掌支桡骨远端骨瓣移植及桡动脉茎突返支蒂桡骨茎突骨瓣移植等。本研究从解剖与临床角度探讨以桡动脉茎突返支为蒂的桡骨茎突骨(膜)瓣移植治疗腕舟状骨骨折的特点及疗效,通过测量桡骨标本发现,桡骨茎突长11~16 mm,满足切取骨瓣的需要;桡动脉茎突返支解剖恒定,位置表浅,易于辨认,术中便于暴露桡动脉茎突返支,且其长度满足转位需求,转位后蒂部不存在扭转及张力等,血管蒂松弛,利于血流畅通,便于骨(膜)瓣存活,与谢文伟

等[18]的研究结果一致。笔者在手术时观察到,即便是腕舟状骨腰部或结节部骨折,桡骨茎突返支蒂长度仍可到达骨折的部位。桡骨茎突返支蒂部与舟骨距离较近,因而易于转位。本研究采用以桡动脉茎突返支为蒂的桡骨茎突骨(膜)瓣移植联合内固定治疗存在骨不连风险的A2型、B型及D2型腕舟状骨骨折,利用桡骨茎突背侧的桡动脉茎突返支为蒂,以桡骨茎突为骨瓣体,移植的同时行桡骨茎突切除,且只需1个切口,符合微创手术原则,避免了术后对腕舟状骨骨折端的剪切应力,对维持骨折的稳定、提高术后康复效果具有重要意义;而陈旧性腕舟状骨骨折采用带血运植骨,可在内固定的基础上改善骨折愈合环境,促进腕关节功能恢复,治疗效果较好。本研究15例患者骨折平均愈合时间为12周,愈合率100%,腕关节功能恢复优良率为86.7%,疼痛减轻,说明该手术方式在改善患肢功能、活动度(屈伸、尺桡偏、旋前旋后)、手握力、疼痛等方面有很好的效果。

但桡骨茎突骨瓣移植手术多为背侧入路,而83.9%的腕舟状骨滋养孔位于背部外侧[19],腕背侧切口易损伤腕舟状骨的滋养动脉,这也是该类手术的缺点之一。

综上,本研究通过测量成人上肢标本桡骨茎突长度,观察桡动脉茎突返支的走行及分布情况,可指导临床治疗腕舟状骨骨折的手术方案制定。桡动脉茎突返支蒂桡骨茎突骨(膜)瓣转位植入治疗腕舟状骨骨折可以有效促进骨折愈合,降低延迟愈合风险,术后腕关节功能恢复良好,临床效果确切。

[参考文献]

[1] Chen S, Zhang C, Jiang B, et al. Comparison of conservative treatment and surgery treatment for acute scaphoid fracture: a meta-analysis of randomized controlled trials[J]. World J Surg, 2023, 47(3): 611-620. doi: 10.1007/s00268-022-06833-1.

[2] Almigdad A, Al-Zoubi A, Mustafa A, et al. A review of scaphoid fracture, treatment outcomes, and consequences[J]. Int Orthop, 2024, 48(2): 529-536. doi: 10.1007/s00264-023-06014-2.

[3] 胥少汀,葛宝丰,徐印坎. 实用骨科学[M]. 北京:人民军医出版社, 2001:269.

[4] Aboelmagd K, Aboelmagd T, Lane JC, et al. A virtual fracture clinic pathway for managing suspected paediatric scaphoid fractures [J]. Cureus, 2022, 14(9): e29238. doi: 10.7759/cureus.29238.

[5] McQueen MM. Hand fractures and dislocations. In: Court-BrownC M, McQueenMM, TornettaP, eds. Orthopaedic surgery essentials: trauma. Philadelphia: Lippincott[M]. Williams and Wilkins, 2006: 170-207.

[6] Kodumuri P, McDonough A, Lyle V, et al. Reliability of clinical tests for prediction of occult scaphoid fractures and cost benefit analysis of a dedicated scaphoid pathway[J]. J Hand Surg Eur Vol, 2021, 46(3): 292-296. doi: 10.1177/1753193420979465.

[7] Lalone EA, MacDermid J, King G, et al. The effect of distal radius fractures on 3-dimensional joint congruency[J]. J Hand Surg Am, 2021, 46(1): 66.e1-66.e10. doi: 10.1016/j.jhsa.2020.05.027.

[8] Douleh DG, Baldini T, Rogers M, et al. Ligament-sparing volar radiocarpal arthrotomy during distal radius fracture repair: anatomical description and quantification of articular surface area visualized in a cadaveric model[J]. J Hand Surg Am, 2024, 49(5): 491.e1-491.e6. doi: 10.1016/j.jhsa.2022.08.015.

[9] Wells ME, Nicholson TC, Macias RA, et al. Incidence of scaphoid fractures and associated injuries at US trauma centers[J]. J Wrist Surg, 2021, 10(2): 123-128. doi: 10.1055/s-0040-1720963.

[10] 陈 诺. 血管化肱骨瓣治疗腕舟骨骨不连的应用解剖与临床研究[D]. 长沙:中南大学, 2022. doi: 10.27661/d.cnki.gzhnu.2022.000895.

[11] 王雪梅,刘新仁. 带血管蒂的桡骨骨膜瓣移植治疗陈旧性腕舟骨骨折19例[J]. 中国局解手术学杂志, 2000, 9(3): 244.

[12] Donndorff AG, Cafruni VM, Bronenberg Victorica P, et al. Description of unusual osteochondral laminar fragment patterns in distal radius fractures[J]. Orthop Traumatol Surg Res, 2022, 108(7): 103321. doi: 10.1016/j.otsr.2022.103321.

[13] 张晓然. 腕舟骨骨折生物力学稳定性的基础和临床研究[D]. 石家庄:河北医科大学, 2022. doi: 10.27111/d.cnki.ghyku.2022.000021.

[14] 杨俊涛. 腕舟骨骨折的诊断与治疗现状[J]. 中南医学科学杂志, 2020, 48(6): 569-571. doi: 10.15972/j.cnki.43-1509/r.2020.06.003.

[15] Yi Z, Qi W, Chen S, et al. A novel mini-invasive technique of arthroscopic-assisted reduction and robot-assisted fixation for trans-scaphoid perilunate fracture dislocations [J]. Orthop Surg, 2023, 15(4): 1203-1209. doi: 10.1111/os.13677.

[16] 蒋云峰,罗 曼,申运山,等. 切开复位哈勃钉内固定植骨联合桡骨茎突筋膜骨瓣治疗陈旧性腕舟状骨骨折的效果及对腕关节功能的影响[J]. 解放军医药杂志, 2022, 34(1): 81-84. doi: 10.3969/j.issn.2095-140X.2022.01.018.

[17] Herrera Ortiz AF, Guevara SZ, Ramírez SM, et al. What is the role of ultrasonography in the early diagnosis of scaphoid fractures?[J]. Eur J Radiol Open, 2021, 8: 100358. doi: 10.1016/j.ejro.2021.100358.

[18] 谢文伟,侯之启,利盛成,等. 桡动脉茎突返支骨(膜)瓣移植治疗手舟骨陈旧性骨折[J]. 中国临床解剖学杂志, 2007, 25(3): 348-350. doi: 10.3969/j.issn.1001-165X.2007.03.035.

[19] 李汉云,钟世镇,徐达传,等. 手舟骨的形态、血供及临床意义[J]. 临床解剖学杂志, 1986, (3): 141-144. doi: 10.13418/j.issn.1001-165x.1986.03.005.

(编辑:龙小芬)