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关节镜下三重固定后交叉韧带胫骨止点撕脱骨折[△]

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摘要: [目的] 介绍关节镜下三重固定治疗后交叉韧带胫骨止点撕脱骨折的手术技术和初步临床结果。[方法] 2022年1月—2023年1月收治18例膝关节后交叉韧带胫骨止点撕脱骨折患者, 建立膝关节前内、前外和后内侧入口, 清理骨折端; 用后交叉韧带重建定位器复位骨折块, 建立骨隧道。抓取2根高强度线, 穿部分后交叉韧带至后关节腔环绕后交叉韧带形成“肚袋环”, 并将高强度线尾端, 双扣板线袢导入骨隧道, 拉紧高强度线尾端, 辅助骨块复位, 锁紧双扣板线袢固定, 并将高强度线与双扣板线袢系统打结固定。最后, 将双扣板线袢辅助后侧牵引线围绕PCL, 经骨隧道引至前侧, 收紧打结固定。镜下依次完成高强度线套环、双扣板线袢和辅助线的三重固定。[结果] 所有患者均顺利完成手术, 手术时间平均(67.0±22.5) min。随访时间平均(12.5±2.7)个月。与术前相比, 术后3个月疼痛VAS评分显著下降[(5.8±1.4), (0.7±0.6), $P<0.001$]。与术前相比, 术后12个月HSS评分[(46.4±9.8), (94.8±3.8), $P<0.001$]和Lysholm评分[(49.4±9.5), (93.4±4.1), $P<0.001$]显著增加。至术后3个月, X线片显示所有患者骨折均愈合。[结论] 关节镜下三重固定治疗后交叉韧带胫骨止点撕脱骨折安全可靠、微创, 提供稳定可靠骨折愈合条件。

关键词: 关节镜, 后交叉韧带胫骨止点撕脱骨折, 双扣板线袢, 高强度线, 三重固定

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Arthroscopic triple fixations of posterior cruciate ligament tibial avulsion fracture // LI Zheng, LI Chang-shu, LIN Bo-ying, YI Xiao-you, LI Li, LUO Jia-xuan. Shenzhen Pingle Orthopedics Hospital (Shenzhen Pingshan District Hospital of Traditional Chinese Medicine), Shenzhen 518118, Guangdong, China

Abstract: [Objective] To introduce the surgical technique and preliminary clinical outcome of arthroscopic triple fixation for posterior cruciate ligament (PCL) tibial avulsion fracture. [Methods] From January 2022 to January 2023, 18 patients received abovementioned surgical treatment for PCL tibial avulsion fracture. After anterolateral, anteromedial and posteromedial portals were created, the intraarticular exploration and debridement were conducted. As the fracture fragment was reduced with PCL tibial guider, a bone tunnel was established anteroposteriorly through the fracture fragment. Grabing 2 high-strength sutures into the joint, passing through and around the PCL to form a "pocket ring", and introducing ends of the high-strength suture and double-button loop sutures into the bone tunnel to tibial front side, tighten the tail end of the high-strength suture to assist the bone fragment reduction, tightening the double-button loop to until the both buttons firmly seated on the bone to fix the fracture fragment, and tied the high strength suture with the button loops suture. Finally, the assisted traction suture of button-loop system on the posterior side was passed around the PCL, and then lead to the front side through the bone tunnel, tightened and knotted to accomplish the triple fixation with the high-strength suture, double-button loop and auxiliary wire in sequence under arthroscope. [Results] All patients had operation performed successfully with operation time of (67.0±22.5) min, and followed up for (12.5±2.7) months. Compared with that preoperatively, the pain VAS score was declined significantly 3 months and postoperatively [(5.8±1.4), (0.7±0.6), $P<0.001$]. In addition, compared with those preoperatively, the HSS score [(46.4±9.8), (94.8±3.8), $P<0.001$] and Lysholm score [(49.4±9.5), (93.4±4.1), $P<0.001$] increased significantly 12 months after operation. All patients got fractures healed well on X ray by 3 months postoperatively. [Conclusion] This arthroscopic triple fixation for PCL tibial avulsion fracture is a safe, reliable and minimally invasive technique, providing stable and reliable fracture healing conditions.

Key words: arthroscopy, posterior cruciate ligament tibial avulsion fracture, double-button loop, high strength suture, triple fixations

后交叉韧带 (posterior cruciate ligament, PCL) 胫骨止点撕脱骨折是一类特殊的膝关节内损伤, 此类骨

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折将导致后交叉韧带张力丧失,进而使得膝关节不稳,同时由于韧带牵拉骨块,故此类骨折不愈合率高^[1]。据国内外学者报道,常规保守治疗PCL胫骨止点撕脱性骨折因缺乏有效方法进行复位和固定往往疗效不满意^[2,3]。对于此类骨折患者,手术治疗是目前的主流治疗方案,但手术方式仍存在争议。临床常用的手术方式包括切开复位内固定术与关节镜下复位内固定术,主要包括切开复位钢板、空心螺钉或锚钉内固定及关节镜下复位锚钉、高强度或微孔钛板内固定等^[4]。关节镜微创手术虽然技术难度较大,但具有切口小、出血少、视野清晰、并发症少、恢复快等优势,故被国内外临床医师普遍采用并取得良好的临床效果^[5,6]。然而,目前关节镜微创手术入路、固定方式及固定材料各具千秋,尚未形成共识^[7]。本研究采用关节镜下双袢钛板联合高强度三重固定新技术,该技术创伤小、固定强度高、操作安全、避免二次手术,现报道如下。

1 手术技术

1.1 术前准备

详细询问患者病史,全面专科查体,完善X线片、CT、磁共振检查及相关术前检验检查,明确诊断,排除手术禁忌证。术前根据影像检查结果,评估撕脱骨折块大小与位置(图1a),做好手术规划。

1.2 麻醉与体位

患者采取插喉罩全麻+神经阻滞麻醉,取俯卧位,患侧大腿根部扎气囊止血带。

1.3 手术操作

常规消毒患侧大腿至足踝,铺无菌巾,无菌包扎患侧足趾至小腿胫骨结节部位。建立常规前内、前外侧入路,置入镜头,顺序探查膝关节各个间室,探查软骨、半月板及前交叉韧带是否损伤。关节镜镜头从前外侧入路经后交叉韧带和股骨内髁间隙插入后内侧室,镜下建立略高于内侧半月板膝后内侧入路,并置入6 mm套管,交替使用刨削刀头、剥离铲、射频电刀,清理显露撕脱完整骨折块,并清理骨折部位瘀血、滑膜碎屑。将后交叉韧带重建定位器调为50°,从前内侧入路经髁间窝抵达后方至撕脱骨折块后上,镜下向下按压复位骨折块(图1b),观察复位满意后置入胫骨定位器导管,胫骨结节前内行1.5 cm纵行切口,经胫骨定位器导管将2.4 mm导针钻向骨折块中央建立骨道,撤除导管,定位器挡板保护下以4.0 mm钻头沿导针扩充骨道,抽出克氏针并留下钻头,将

PDS线双折后经空心钻头从前向后穿出骨块表面,用抓线钳从后内侧入路引出PDS线,撤走钻头并将PDS线折端离断成2根,血管钳夹持两端备用。抓线钳将1根对折后高强度线由前内入路穿1/2部分PCL至后关节腔环绕PCL形成“肚带环”(图1c),抓钳将高强度线尾经后内侧入路引出;将另1根对折后高强度线稍高于已有高强度线不穿PCL环绕PCL形成“肚带环”,将尾线经后关节腔由后内入路拉出,选取1根PDS线将2根高强度线尾线经撕脱骨块至胫骨隧道出胫骨前入口拉出。取1套双袢钛板由另1根PDS线经胫骨前骨道将一端微孔钛板带入至后关节腔撕脱骨块后部,将钛板辅助线经后交叉内外侧引出至前内侧入路,牵拉辅助线调整钛板位置,将钛板压迫于骨块上,收紧两根高强度线复位骨折块(图1d),监视观察到钛板横跨并压紧复位后骨折块,位置合适收紧带袢线(图1e),将膝前纽扣带袢线拉紧打结后再将高强度线收紧打结。镜下将2根环绕后交叉韧带钛板辅助线捆绑打结防止钛板旋转移位(图1f),后关节腔镜下观察三重固定牢固、骨折无移位(图1g),关闭切口。

1.4 术后处理

手术当天:卧床休息为主,同时抬高患肢,行踝泵运动;术后第1d~1个月:摄X线片(图1h),膝关节活动支具固定,小腿稍垫高,膝关节活动范围0°~90°,双拐辅助下部分负重,并加强股四头肌肌力锻炼;术后1~3个月:逐渐负重下地活动,增加膝关节活动度至120°;术后3个月以后:去除膝关节支具,可完全负重,增加膝关节活动度至140°,逐渐恢复日常生活活动。

2 临床资料

2.1 一般资料

2022年1月—2023年1月18例膝关节后交叉韧带胫骨止点撕脱骨折患者纳入本研究,男13例,女5例,年龄18~50岁,平均(34.4±12.1)岁,左膝10例,右膝8例,病程2~15 d;所有患者均由外伤导致,表现为膝关节肿胀、疼痛,部分患者伴有皮肤擦伤,待创面结痂稳定后行手术治疗。患者术前均行膝关节X线片、CT、MRI检查,评估膝关节退变及撕脱骨折情况。手术均由同一手术麻醉团队完成。本研究经医院伦理委员会审批,患者均签署知情同意书。

2.2 初步结果

所有患者均顺利完成手术，手术时间平均 (67.0 ± 22.5) min，均未发生神经血管损伤、手术部位感染等并发症。患者均获得随访，随访时间 12~18 个月，平均 (12.5 ± 2.7) 个月。疼痛 VAS 评分由术前的 (5.8 ± 1.4) 分显著下降至术后 3 个月的 (0.7 ± 0.6) 分 $(P < 0.001)$ ，HSS 评分、Lysholm 评分分别由

术前的 (46.4 ± 9.8) 分、 (49.4 ± 9.5) 分显著提升至术后 12 个月的 (94.8 ± 3.8) 分 $(P < 0.001)$ 、 (93.4 ± 4.1) 分 $(P < 0.001)$ 。术后 12 个月 KT-1000 稳定性测试^[8]：患侧为 (2.1 ± 0.4) cm，健侧为 (1.8 ± 0.5) cm，两者比较差异无统计学意义 $(P = 0.386)$ 。术后 3 个月复查 X 线片示骨折均愈合。

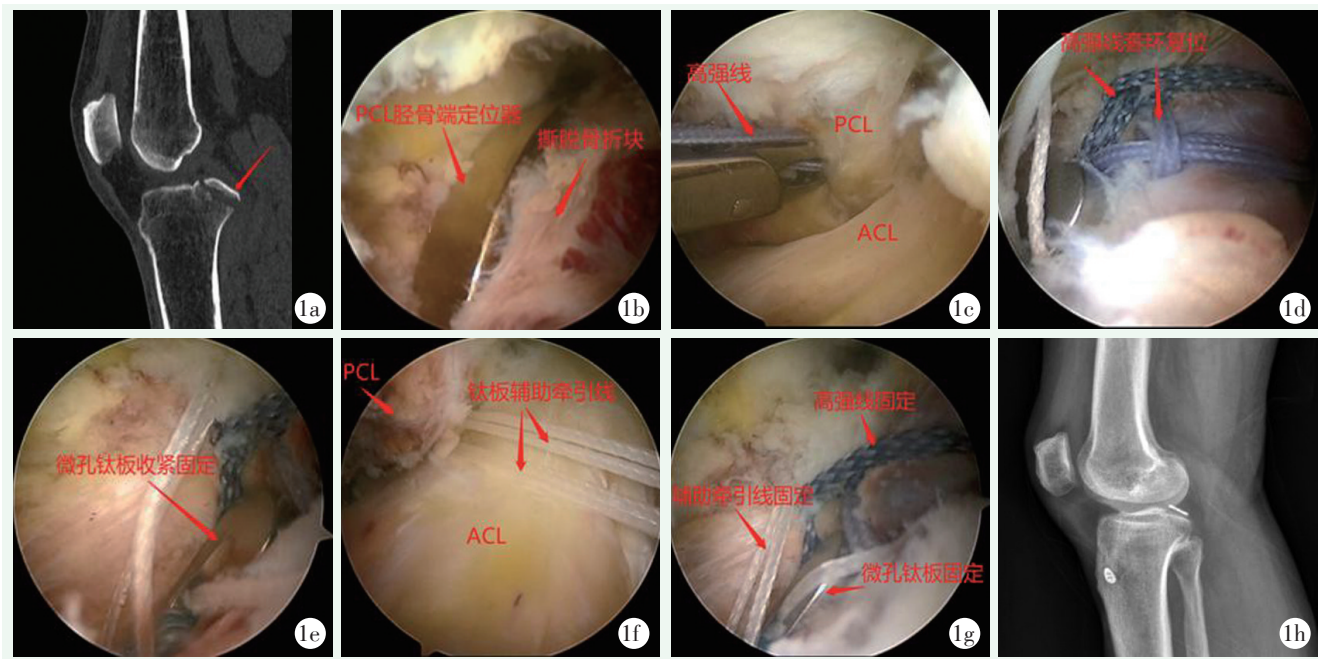


图 1. 患者女性，40 岁。1a：术前矢状位 CT 平扫片示后交叉韧带胫骨止点部位撕脱骨折并移位；1b：PCL 胫骨定位器复位骨折块；1c：高强线穿部分 PCL 入后关节腔；1d：双套环高强线复位骨折块；1e：收紧固定微孔钛板；1f：钛板辅助牵引线拉入前关节腔环绕 PCL 打结固定；1g：镜下见高强线、微孔钛板、辅助牵引线三重固定；1h：术后矢状位 X 线片示骨折对位对线良好。

Figure 1. A 40-year-old female. 1a: Preoperative sagittal CT showed PCL tibial avulsion fracture with displacement; 1b: Arthroscopic view of the fracture fragment reduced with PCL tibial guide; 1c: High-strength sutures was introduced into the joint, and passed through the PCL; 1d: Double loops of high-strength suture were tightened to reduce fracture fragment; 1e: Tightening the suture loops, the button plate confirmed seated on the bone block; 1f: The button auxiliary traction suture pulled into the joint around the PCL to be tied and fixed; 1g: High strength suture, button plate suture and auxiliary traction suture were tightened and fastened triply to accomplish the fixation under arthroscope; 1h: Postoperative sagittal X-ray showed that the fracture reduced well with implants in good position.

3 讨论

后交叉韧带胫骨止点撕脱骨折治疗方式较多，例如内侧小切口空心螺钉固定、关节镜辅助下钛板、高强线及锚钉固定等，均取得了优良的结果^[7, 9]，但是目前依旧存在手术入路、固定方式、胫骨骨道等不确定的做法，随着关节镜技术的发展，关节镜下使用钛板及高强线固定已成为主流治疗方式^[10]。唐兆鹏等^[11]使用高强线穿过 Endo-Button 钛板行复位及固定，随访 1 年余均达到良好的效果，此法依靠 1 根高强线固定，相比之下固定强度不足。而付允等^[12]采用后内侧双入路、双 Endo-button 带袢钢板固定后交

叉韧带胫骨止点撕脱骨折，亦取得良好的随访结果，此法的双后内入路视野良好，且使用 2 根高强线固定，固定强度增加，但增加了切口及创伤。Xu 等^[13]使用单胫骨骨道及 1 根高强线联合外排锚钉固定，随访效果满意，此法使用内固定耗材极少，经济效益显著，但单纯使用高强线行复位及固定，强度不足，且在隧道位置不当或复位不良时不易稳定骨折，容易出现复位不良或固定失效的情况。

本研究着重于加强固定强度，将复位及固定分开操作，先使用 2 根高强线捆扎后交叉韧带，起到维持复位及张力带辅助固定作用，可以防止最终收紧钛板固定时骨块再次移位，采用带袢钛板行最终固定，依靠钛板-带袢线-钛板之间的“弹性固定”，兼顾固定

强度及操作方便,最后将2根钛板的辅助线围绕后交叉韧带捆绑打结,防止钛板移位和钛板滑脱至骨道,从而实现“三重固定”,相较于其他方法,该术式同时做到骨折复位、相对坚强固定,特别适合一些骨块形状特殊、骨块较小或是骨块碎裂的情况。本研究采用的“三重固定”能够在技术上解决文献报道中的一些复位不佳、固定失效等不足之处^[14-16]。初步结果显示,VAS评分下降速度与文献报道基本一致^[17, 18]。最终HSS评分、Lysholm评分略高于文献报道^[15, 18]。术后12个月KT-1000稳定性测试结果显示患侧稳定性与健侧比较无统计学差异,提示本研究的手术技术在恢复膝关节稳定性方面的效果优秀。

综上所述,关节镜下三重固定治疗后交叉韧带胫骨止点撕脱骨折安全可靠、微创,能提供稳定可靠的骨折愈合条件、有效缓解疼痛、改善膝关节功能、维持关节稳定,值得推广应用。

利益冲突声明 所有作者声明无利益冲突

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