

双滑轮结合缝线桥技术治疗髌骨下极粉碎性骨折

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【摘要】 目的:探讨双滑轮结合缝线桥技术治疗髌骨下极粉碎性骨折的临床疗效。**方法:**2018 年 1 月至 2020 年 6 月采用双滑轮结合缝线桥技术治疗 15 例髌骨下极粉碎性骨折患者, 其中男 9 例, 女 6 例, 年龄 28~68(42.4±9.6) 岁。患者伤后均有明显膝关节疼痛及活动受限, 均行膝关节 X 线和 CT 检查, 明确为髌骨下极粉碎性骨折。术后定期拍摄膝关节 X 线片了解骨折愈合情况并测量 Insall-Salvati 指数, 记录关节活动度, 并采用 Bostman 评分系统评价术后膝关节功能。**结果:**15 例患者均获得随访, 随访时间 7~24(11.4±4.2) 个月, 无明显膝前痛病例。末次随访时患肢膝关节活动度为 105°~140°(128.5±12.8)°, Insall-Salvati 指数为 0.79~1.12 (0.92±0.18)。X 线片提示髌骨均骨性愈合, 未见锚钉脱落、断裂及骨折块移位等情况。Bostman 髌骨骨折功能评分(27.85±2.06)分, 优 13 例, 良 2 例。**结论:**双滑轮技术结合缝线桥技术治疗髌骨下极粉碎性骨折复位固定可靠, 术后患者可早期开始功能锻炼。

【关键词】 髌骨骨折; 粉碎性骨折; 内固定
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Double-pulley combined with suture bridge technique for fixation of comminuted fractures of distal patella pole
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ABSTRACT Objective To investigate the clinical effect of double pulley combined with suture bridge in the treatment of comminuted fracture of the lower pole of the patella. **Methods** From January 2018 to June 2020, 15 patients with comminuted fracture of the lower pole of the patella were treated with double pulley and suture bridge technology, including 9 males and 6 females, aged 28 to 68 years old with an average of (42.4±9.6) years old. All patients had obvious knee joint pain and limited movement after injury. All knee joints were examined by X-ray and CT, which confirmed that they were all comminuted fractures at the lower level of the patella. After operation, X-ray films of the knee joint were taken regularly to understand the fracture healing, the Insall Salvati index was measure, the range of motion of the joint was recorded, and the function of the knee joint was evaluated by the Bostman scoring system. **Results** All the 15 patients were followed up for 7 to 24 months with an average of (11.4±4.2) months, and there was no obvious anterior knee pain. At the last follow-up, the knee joint range of motion of the affected limb was 105° to 140° with an average of (128.5±12.8)°, and the Insall Salvati index was 0.79 to 1.12 with an average of (0.92±0.18). The X-ray film showed that the patella was bone healing, and no anchor fell off, broken, or displaced fracture block was found. Bostman patellar fracture function score was 27.85±2.06, 13 cases were excellent, 2 cases were good. **Conclusion** Double pulley technique combined with suture bridge technique is reliable for reduction and fixation of comminuted fracture of the lower pole of patella, and patients can start functional exercise early after operation.

KEYWORDS Patella fracture; Comminuted fracture; Internal fixation

髌骨下极骨折是髌骨骨折中较为特殊的类型, 约占髌骨骨折的 5%^[1]。骨折块相对较小且多为粉碎性, 常合并髌韧带损伤甚至断裂, 不恰当的治疗会造成髌骨高度丢失、关节囊挛缩、关节粘连、髌股关节磨损、退变, 严重削弱伸膝装置功能^[2]。回顾分析 2018 年 1 月至 2020 年 6 月收治的 15 例髌骨下极粉碎性骨折病例, 采用了双滑轮结合缝线桥技术, 报告如下。

1 资料与方法

1.1 病例选择

纳入标准: (1) 年龄 18~80 岁。 (2) 闭合性新鲜性髌骨下极粉碎性骨折。 (3) 骨折不涉及或涉及很少髌骨关节面。排除标准: (1) 合并髌骨体部或上极骨折。 (2) 膝关节既往手术者。 (3) 膝关节既往功能障碍者。 (4) 合并同侧肢体其他部位骨折。 (5) 严重骨质疏松者。 (6) 既往代谢性疾病及精神病者。 (7) 随访时间 < 6 个月者。

1.2 临床资料

本组共纳入患者 15 例, 男 9 例, 女 6 例; 年龄

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28~68(42.4±9.6)岁;左侧 5 例,右侧 10 例。致伤原因:摔伤 6 例,交通事故伤 4 例,运动损伤 2 例,高处坠落伤 2 例,撞击伤 1 例。伤后至手术时间 1~9(3.4±1.1) d。

1.3 治疗方法

1.3.1 手术方法 硬膜外麻醉成功后,患者取平卧位,大腿近端上气囊止血带。常规膝前纵行切口,逐层切开,暴露骨折断端、髌韧带及两侧支持带。清除骨折断端嵌插的软组织及关节内凝血块,尽量保留髌骨下极粉碎性骨折块上的腱膜及髌韧带。(1)在近端骨折块的两下角,斜向内上 45°打入 2 枚 3.5 mm 的带线锚钉(Arthrex 公司),锚钉位置尽量靠近两侧皮质(图 1a)。(2)锚钉上相同颜色的缝合线作为一束,取 2 枚锚钉上同颜色的缝线的一端分别从紧贴髌骨下极远端骨折块的下缘同一点穿出并打结。(3)另一束缝线重复第(2)步操作,缝线从骨折块下缘的对称位置穿出并打结(图 1b)。(4)以 2 枚锚钉的尾孔为滑轮,牵拉收紧同一束缝线的两端,髌韧带内缝线将髌骨下极骨折块及软组织托举复位,完成双滑轮固定(图 1c)。(5)重复第(2)步操作,缝线的另一端穿过髌韧带后打结固定。(6)将打结后的缝线交叉在髌骨前方形成缝线桥,于髌骨上级股四头肌腱两侧外排锚钉处固定(图 1d)。减去多余缝线,修补髌腱膜及两侧支持带,屈膝至 120°检查骨折稳定性。冲洗创面、缝合伤口。

1.3.2 术后处理 术后患肢常规佩戴可调节式支具固定,麻醉苏醒后即开始踝泵及股四头肌等长收缩训练。术后 1 d 开始主动屈伸膝关节锻炼,术后 1 周屈膝至 45°,4 周屈膝至 90°,6 周屈膝至 120°,期间加强股四头肌主被动功能锻炼,鼓励患者在支具保护下负重行走。术后 6 周丢弃支具,并逐渐恢复至正常的膝关节活动度。

1.4 观察项目与方法

记录膝关节活动度(range of motion,ROM)及手术并发症发生情况,拍摄双侧膝关节 X 线片了解骨折愈合情况并测量 Insall-Salvati 指数^[3],按照 Bostman 髌骨骨折功能评分^[4]评定术后膝关节功能,包括运动范围、疼痛、工作、肌萎缩、辅助物、积液、打软腿、爬楼梯,结果优 28~30 分,良 20~27 分,差<20 分。

1.5 统计学处理

采用 SPSS 22.0 软件进行统计分析,定量资料以均数±标准差($\bar{x}\pm s$)表示,术前后 Insall-Salvati 指数比较采用配对 *t* 检验;*P*<0.05 为差异有统计学意义。

2 结果

15 例患者术后均获得随访,随访时间 7~24(11.4±4.2)个月,股四头肌肌力均为 V 级,无明显膝前痛病例。患肢膝关节活动度:术后 1 周为 35°~60°(45.8±9.1)°,术后 1 个月为 85°~120°(105.8±10.4)°,末次随访时为 105°~140°(128.5±12.8)°。Insall-Salvati 指数:术后即刻患肢为 0.80~1.09(0.94±0.12),健

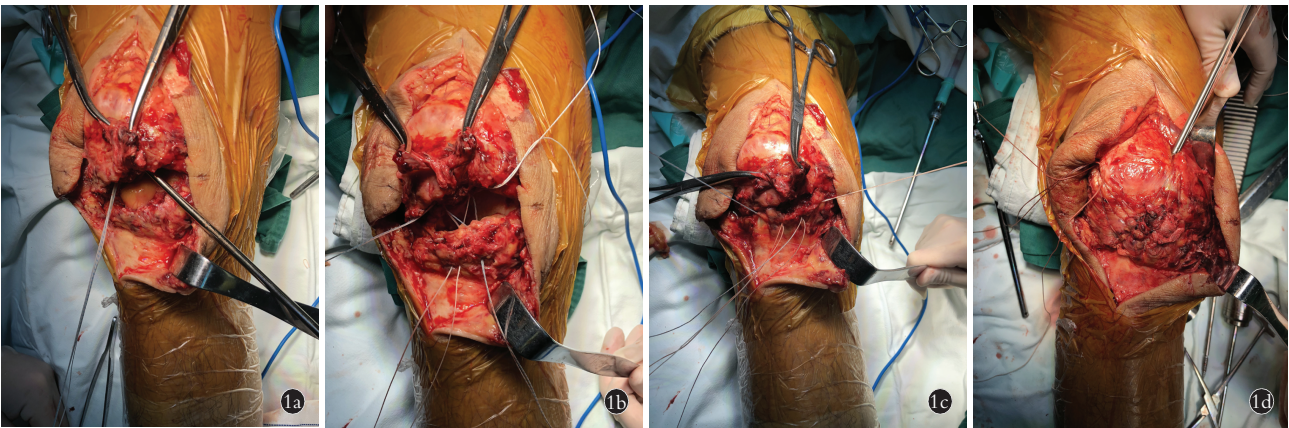


图 1 患者,男,65 岁,髌骨下极粉碎性骨折,双滑轮结合缝线桥技术手术过程 1a. 在近端骨折块的两下角,斜向内上 45°打入 2 枚 3.5 mm 的带线锚钉,锚钉位置尽量靠近两侧皮质 1b. 取 2 枚锚钉上同颜色的缝线的一端分别从紧贴远端骨折块的下缘同一点穿出并打结 1c. 以 2 枚锚钉的尾孔为滑轮,牵拉收紧同一束缝线的两端,髌韧带内缝线将髌骨下极骨折块及软组织托举复位,完成双滑轮固定 1d. 将打结后的缝线交叉在髌骨前方形成缝线桥,于髌骨上级股四头肌腱两侧外排锚钉处固定

Fig.1 A 65-year-old male patient with comminuted fracture of the lower pole of the patella, who underwent double pulley and suture bridge surgery 1a. At the two lower corners of the proximal fracture block, drive two 3.5 mm threaded anchor nails at an angle of 45° inwards and upwards. The anchor nails should be located as close to the cortex on both sides as possible 1b. Take one end of the suture of the same color on the two anchor nails to pierce and knot from the same point close to the lower edge of the distal fracture block 1c. Take the tail holes of two anchor nails as pulleys, pull and tighten both ends of the same suture bundle, and use the internal suture of patellar ligament to lift and reposition the lower pole fracture block of patella and soft tissue to complete the fixation of double pulleys 1d. Cross the knotted suture in front of the patella to form a suture bridge, and fix it at the external anchor nails on both sides of the quadriceps tendon at the superior patella

肢为 0.92~1.20(1.02±0.10), 两侧比较差异无统计学意义 ($t=-2.42, P=0.06$); 末次随访时患肢为 0.79~1.12(0.92±0.18)、健肢为 0.92~1.22(1.03±0.12), 两侧比较差异无统计学意义 ($t=-2081, P=0.08$)。末次随访时 X 线片检查提示髌骨均骨性愈合, 未见锚钉脱落、断裂及骨折块移位、不愈合等情况; Bostman 髌骨骨折功能评分运动范围 5.85±0.66, 疼痛 5.85±0.66, 工作 4.00±0.00, 肌萎缩 3.88±0.48, 辅助物 3.88±0.48, 打软腿 1.48±0.50, 爬楼梯 1.55±0.50, 总分 27.85±2.06, 优 13 例, 良 2 例。典型病例影像学资料及功能恢复情况见图 2。

3 讨论

髌骨下极粉碎性骨折作为髌骨骨折治疗的难点之一, 由于骨折粉碎, 骨折块较小, 有时还呈冠状位劈裂, 加之此处应力相对集中, 难以维持有效复位及坚强固定^[5]。此外, 该部位骨折常伴随髌韧带止点处撕脱, 在处理骨折块的同时需修复髌韧带的起点, 以最大限度地恢复伸膝功能。目前髌骨下极粉碎性骨折的治疗尚无统一的标准, 无论采用何种处理方式, 在恢复伸膝装置的连续性、保证稳定固定的前提下尽早开始膝关节功能锻炼是获得良好预后的关键^[6]。

切除髌骨下极不可避免会产生髌骨下移, 致使髌-股关节面发生“错格”^[7]。这将引起载荷传导功能紊乱, 容易导致创伤性关节炎的发生。此外, 髌韧带

与髌骨之间属于骨-腱性组织的瘢痕愈合, 抗牵拉能力较弱, 术后还需长时间的外固定, 目前临床治疗中已较为少见^[8]。克氏针张力带技术作为髌骨骨折最经典的固定方法, 主要适用于髌骨横断骨折以及骨折块较大、粉碎程度较轻的骨折。对于骨折块粉碎、冠状面存在劈裂的患者则难以达到理想的固定效果, 此外, 文献报道克氏针还有松动、脱落、断裂、刺激甚至穿出皮肤引起感染等风险^[9-10]。近年也有一些学者尝试了新型固定方式或对传统的技术加以了改良, 如髌骨篮状钢板、独立垂直钢丝固定技术、带线锚钉等^[11-12]。其中带线锚钉由于手术操作简单、组织相容性高、生物力学稳定、最大限度地保留了髌韧带的完整性以及无须二次手术取出等优点, 逐渐受到临床医师的青睐^[13]。

锚钉拔出是带线锚钉固定失败的主要形式, 为此国内外学者对置钉技术进行了一系列改良^[14]。AKTAY 等^[15]研究证实锚钉尾部缝线拉力与锚钉长轴成 90°比 0°有更大的抗拔出。ROBB 等^[16]研究发现, 多枚锚钉单独打结固定时, 各枚锚钉发生拔出并不同步, 而是总有 1 枚锚钉要比其他锚钉首先出现拔出, 并解释该现象可能与各枚锚钉缝线在打结时的收紧程度不一有关, 因此收得最紧的线结在屈膝时首先被拉紧而使这枚锚钉承担了更大的张力。为了克服各枚锚钉张力不一的情况, 陈羽等^[17]设计了



图 2 患者,男,65 岁,髌骨下极粉碎性骨折接受双滑轮结合缝线桥技术手术(与图 1 为同一患者) 2a. 术前侧位 X 线片示髌骨下极粉碎性骨折 2b. 术前 MRI 矢状位示髌韧带断裂 2c. 术后 CT 矢状位重建示骨折块解剖复位, 关节面平整 2d. 术后 MRI 矢状位示髌韧带连续性恢复 2e,2f. 术后 6 个月患膝屈伸功能基本恢复正常

Fig.2 A 65-year-old male patient with comminuted fracture of the lower pole of the patella underwent double pulley suture bridge technique(The same patient as Fig.1) 2a. Preoperative lateral X-rays showed displacement of distal fragments 2b. Preoperative sagittal MRI showed complete rupture of patellar tendon 2c. Immediate postoperative sagittal CT showed patellar fracture with anatomical reduction and articular surface was smooth 2d. Immediate preoperative sagittal MRI showed the continuity of the patellar ligament has been repaired 2e,2f. The flexion and extension of injured knee at 6 months after operation was basically normal

双滑轮技术治疗髌骨下极粉碎性骨折, 穿过骨折远端与髌韧带交界处的 4 根缝线, 两两平衡, 避免了因松紧的差异使张力集中在某一根较紧的线上, 对髌骨下极形成了吊床样弧形托举。不过为了达到术后早期功能锻炼的目的, 该方法同样需要辅助钢缆“8”字张力带作为对带线锚钉的保护, 以抵消屈膝时髌骨表面所形成的张力。笔者则在此基础上进一步作了改良, 在双滑轮技术的基础上采用双排缝线桥技术代替张力带钢丝, 在膝关节屈曲时不仅可以同样起到张力带效应, 达到早起锻炼的效果, 而且术后可行磁共振检查也无须二次手术取出内固定^[13]。

髌韧带收紧短缩后引起的继发性低位髌骨是带线锚钉固定的另一担忧。研究显示相较于 Blackburne-Peel 指数以及 Caton-Deschamps 指数, Insall-Salvati 指数可重复性更高^[18]。因此, 测量术后膝关节 Insall-Salvati 指数并与健侧进行了对比, 术后即刻及末次随访时患侧 Insall-Salvati 指数较健侧均有所降低, 但差异无统计学意义, 随访过程中患侧 Insall-Salvati 指数也未见明显变化, 提示髌韧带短缩并不会随着膝关节功能锻炼而进一步加重, 而且患者膝关节功能良好, 无明显膝前痛及髌股关节不稳等症状, 提示即使髌韧带会有一些程度的短缩, 也不至于引起严重的临床并发症。

总之, 双滑轮技术结合缝线桥技术治疗髌骨下极粉碎性骨折生物力学稳定, 固定效果可靠, 利于术后早期功能锻炼, 值得临床推荐。不过, 锚钉固定强度有赖于近端骨折块的完整性和骨骼强度, 因此对于近端同样存在骨折线或严重骨质疏松者应谨慎使用。此外, 本研究仅是一项单纯性回顾研究, 缺乏与其他固定方式的比较, 加之样本量相对较小、随访时间较短, 因此关于该技术的最佳适应证及手术技术仍需开展更多病例、更长期的临床验证。

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