

· 技术创新 ·

浅隧道双线环固定重建内侧髌股韧带

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摘要: [目的] 介绍浅隧道双线环固定术重建内侧髌股韧带 (medial patellofemoral ligament, MPFL) 的手术技术和初步临床结果。[方法] 2021年1月—2022年1月, 对30例髌骨脱位患者采用浅隧道双线环固定 MPFL 重建。首先于髌骨内侧上和体部定位, 钻入2枚带尾孔导针对侧, 使用4.5 mm 空心钻沿带尾孔导针制作两个深约5 mm 的浅隧道。利用带尾孔导针两骨道各引入1根引线。再用引线将对折的2根线环反向引入双隧道。将肌腱移植物置于2个线环中, 分别收紧线环, 将肌腱移植物引入浅隧道, 紧密贴合后, 打结固定。将肌腱移植物经深筋膜下引至股侧切口, 制作股骨隧道, 将移植物引入, 适当张力下, 挤压螺钉固定。[结果] 所有患者均顺利完成手术, 无严重并发症, 随访12~24个月。与术前相比, 末次随访时膝关节活动度 [(63.3±18.2)°, (121.4±4.7)°, $P<0.001$]、VAS 评分 [(6.4±0.9), (1.9±0.5), $P<0.001$]、IKDC 评分 [(38.2±6.5), (79.9±5.3), $P<0.001$]、髌骨倾斜角 [(23.7±4.2)°, (12.1±3.2)°, $P<0.001$] 及髌骨适合角 [(18.9±3.1)°, (-5.5±1.3)°, $P<0.001$] 均显著改善。[结论] 浅隧道双线环固定术重建内侧髌股韧带治疗髌骨脱位或半脱位可减少医源性损伤, 取得良好临床疗效。

关键词: 髌骨脱位或半脱位, 内侧髌股韧带重建, 浅隧道, 双线环

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Double shallow patellar tunnels and suture loops fixation for medial patellofemoral ligament reconstruction // ZHOU Ming, GONG Li, HOU Hui-ming, ZOU Wen, FAN Shao-yong, HU Liang-shen. Nanchang Hongdu Hospital of Traditional Chinese Medicine, Nanchang 330008, China

Abstract: [Objective] To present the surgical technique and preliminary clinical outcomes of double shallow patellar tunnels and suture loops fixation for medial patellofemoral ligament reconstruction. [Methods] From January 2021 to January 2022, 30 patients with patellar dislocation were treated with abovementioned MPFL reconstruction. After location on the medial edge of the patella, two guide pins with tail holes were transversely drilled into the opposite side. Two shallow tunnels 5mm in depth were created by a cannulated drill 4.5 in diameter over the guide pins. Use a guide pin with a tail hole, leading PDS suture was introduced into each bone tunnel. Then, using the leading PDS, two suture loops were induced into both bone tunnels. As the tendon graft was placed into two suture loops, the suture ends were tightened simultaneously to fit tendon graft into the shallow tunnels and fixed with knots. The tendon graft was led under the deep fascia to the femoral incision, the femoral tunnel was made, the graft was introduced, and an interference screw was inserted to fix the reconstructed MPFL in appropriate tension. [Results] All the patients had MPFL reconstructed successfully without serious complications, and were followed up for 12 to 24 months. Compared with those preoperatively, knee range of motion (ROM) [(63.3±18.2)°, (121.4±4.7)°, $P<0.001$], VAS score [(6.4±0.9), (1.9±0.5), $P<0.001$], IKDC scores [(38.2±6.5), (79.9±5.3), $P<0.001$], patellar tilt [(23.7±4.2)°, (12.1±3.2)°, $P<0.001$] and patellar congruency angle [(18.9±3.1)°, (-5.5±1.3)°, $P<0.001$] are improved significantly at the last follow-up. [Conclusion] Reconstruction of medial patellofemoral ligament with double shallow tunnels and double suture loops fixation did reduce iatrogenic trauma and achieve good clinical consequences for patella dislocation or subluxation.

Key words: patellar dislocation or subluxation, medial patellofemoral ligament reconstruction, shallow tunnel, double suture loops

内侧髌股韧带 (medial patellofemoral ligament, MPFL) 是限制髌骨外移最重要的静态稳定结构。研究表明, 屈膝 30° 时, MPFL 提供了约束髌骨外移 50%~60% 的拉力^[1, 2]。而在髌骨脱位过程中, 约

95% 的患者会出现 MPFL 的断裂或者失效^[3]。因此, 无论对于急性髌骨脱位或是复发性脱位, 重建 MPFL 是最基础的手术方式。目前, 临床上 MPFL 的重建方式多种多样, 但主要区别在于髌骨侧固定方式选择

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上,其包括经骨隧道固定、界面螺钉固定、锚钉缝合固定及髌骨筋膜缝合固定。经骨隧道固定相比于其他几种术式能够提供更大的最大失效负荷,且有着更好的腱骨愈合,但存在术后髌股关节痛及髌骨骨折的风险^[4-6]。界面螺钉固定一定程度上增加腱骨愈合可能性,但易造成韧带实质部的破坏,增加肌腱断裂的风险,同时会出现术后关节僵硬情况^[7]。锚钉缝合固定虽然能够取得与经隧道固定术相同的临床疗效,其固定韧带的方式为附着于骨表面,未能很好地形成腱骨愈合,且术后会增加髌骨倾斜程度^[8]。髌骨筋膜缝合提供的抗拉力较小,术后早期限制活动,增加了关节僵硬风险。而近来有文献提出对于经骨隧道固定术,短、小的骨隧道更能降低髌骨骨折风险并减轻髌股关节疼痛,且临床疗效相似^[9]。因此,为了获得较大的抗拉力,促进腱骨愈合,并降低髌骨骨折风险及髌骨疼痛感,本文在经骨隧道固定方式上进行改良,采用浅隧道双线环固定术重建 MPFL 治疗髌骨脱位,取得了良好的临床疗效,现报道如下。

1 手术技术

1.1 术前准备

术前膝关节 MRI 显示髌骨脱位伴髌骨内侧撕脱骨折(图 1a),膝关节 CT 示胫骨结节-股骨滑车间距离(TT-TG)值 <20 mm。患者有明确的外伤史。排除合并其他部位损伤以及神经血管损伤者,排除合并心脑血管疾病,不能耐受手术者。完善相关检查。准备手术器械,包括关节镜动力刨削系统,取腱器,4.5 mm 及 5.0 mm 空心钻,带尾孔导针,2.0 克氏针,2 号肌腱线,普迪丝(PDS)缝线及 6 mm 的挤压螺钉。

1.2 麻醉与体位

患者在腰硬联合麻醉下实施手术,取仰卧位,患肢大腿远端外侧放置挡板,足跟部放置衬垫。

1.3 手术操作

首先于外踝尖后缘处取腓骨长肌一半肌腱,制备重建的髌股韧带移植。使用关节镜设备清理关节腔中积血、增生滑膜及软骨碎片,并检查有无合并其余结构损伤。然后沿髌骨内侧中上缘处作长约 3 cm 的纵行切口,分离皮下组织,充分暴露髌骨内上缘,使用磨头进行打磨使之微微渗血。于股骨内上髌结节,腓肠肌内侧头结节以及内收肌结节之间所形成的“马鞍区”作长约 2 cm 的斜行切口,分离皮下组织、深筋膜直达骨面。分于髌骨上 1/2 位置三等分点水平钻

入 2 枚克氏针,股骨内侧“马鞍区”内斜向外上方钻入 1 枚克氏针,并进行术中透视,确定隧道口位置良好(图 1b)。

沿髌骨内上缘克氏针标记位置使用带尾孔导针钻入,直达外侧。使用 4.5 mm 空心钻沿带尾孔导针制作长约 5 mm 的浅隧道(图 1c)。利用带尾孔导针各引入 1 根 PDS 线环(图 1d),将两根 PDS 线在髌骨外侧面使用血管钳皮下分离,经小切口引出,剪断 PDS 线,分别与另一骨道的 PDS 线打结,还纳入至髌骨外缘(图 1e)。内侧两隧道的 2 条 PDS 的一端线分别与 1 个缝线束环打结,牵拉 PDS 线,将缝线环自一个骨道内侧口,从另一个骨道内侧口引出(图 1f),每一骨道内侧口分别形成一个缝线环和另一骨道缝线环及线尾(图 1g)。然后将肌腱移植中部套入 2 个骨道的缝线环中(图 1g)。同时收紧缝线尾端,使肌腱移植引入浅隧道,充分贴合,打结固定(图 1h)。将肌腱移植经深筋膜下引至股后内侧切口。使用 4.5 mm 及 5.0 mm 空心钻制作股骨隧道,利用带尾孔导针引入引线,将肌腱另一端拉入股骨隧道中。在股骨端维持肌腱一定张力,并反复屈伸膝关节,见髌骨轨迹正常。于膝关节屈曲 90°位置拧入挤压钉。若出现髌骨外侧皮肤凹陷则进行外侧支持带松解。

利用髌骨端剩余肌腱线对髌骨内侧支持带进行缝合。镜下见髌股关节位置正常。最后放置引流,逐层缝合切口。

1.4 术后处理

术后第 2 d 开始行踝泵训练,背伸踝关节维持 10 s,然后跖屈踝关节维持 10 s 为 1 组,连续 30 组,2 次/d。术后 3 d~2 周,拔出引流管后,在踝泵训练基础上增加行直腿抬高训练,床边主动屈伸膝关节训练且膝关节屈曲角度逐渐到达 90°,并佩戴膝关节铰链支具负重行走,支具角度为 0°。术后 3~4 周,膝关节主动屈曲达 120°,将膝关节支具角度调为 90°,并调整患者行走步态至正常。术后 6 周移除支具,正常行走。术后 12 周可行适当运动例如慢跑等。术后半年恢复正常生活,可适当参加对抗性运动。

2 临床资料

2.1 一般资料

选取本院 2021 年 1 月—2022 年 1 月收治的 30 例髌骨脱位患者为研究对象,男 13 例,女 17 例,年

龄 18~30 岁, 平均 (23.4±3.9) 岁; 左膝 18 例, 右膝 12 例; 非接触性损伤 18 例, 接触性损伤 12 例; 测得术前 TT-TG 值为 (17.0±1.8), Caton 指数为 (1.0±0.1); 伴髌骨内侧撕脱骨折患者 9 例。本研究经医院伦理委员会审批通过, 所有患者均知情同意。

2.2 初步结果

所有患者均顺利完成手术, 术中无神经、血管损伤等情况。所有患者均获随访, 随访时间 12~24 个月, 平均 (18.4±2.8) 个月。末次随访时, 膝关节屈伸活动度由术前 (63.3±18.2)° 显著增加至 (121.4±

4.7)° ($P<0.001$); VAS 评分由术前 (6.4±0.9) 显著降低至 (1.9±0.5) ($P<0.001$); IKDC 评分术前 (38.2±6.5) 显著增加至 (79.9±5.3) ($P<0.001$); 髌骨倾斜角 (股骨内外髌连通髌骨最大横径线的夹角) 由术前 (23.7±4.2)° 显著降低至 (12.1±3.2)° ($P<0.001$); 适合角 (股骨滑车沟角的平分线与股骨滑车最低点与髌骨关节面嵴最低点连线的夹角) 由术前 (18.9±3.1)° 显著减少至 (-5.5±1.3)° ($P<0.001$)。所有患者术后均未出现再脱位。

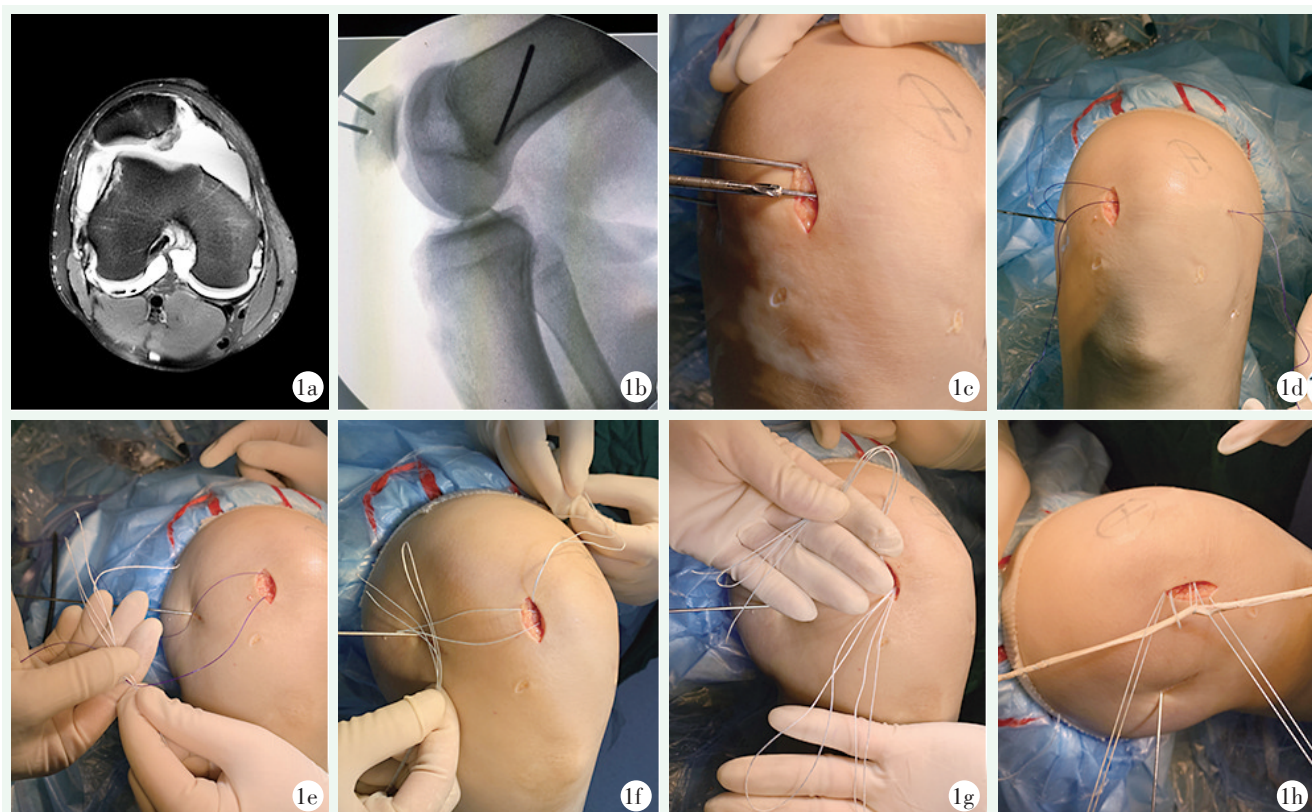


图 1. 患者男性, 18 岁。1a: 术前右膝 MRI 示右膝髌骨向外侧半脱位; 1b: 透视定位重建内侧髌股韧带髌骨侧及股骨位隧道口; 1c: 髌骨内侧钻入 2 枚带尾孔导针, 4.5 mm 空心钻进行扩隧道, 以制作 5 mm 浅隧道; 1d: 利用导针各引入 1 根 PDS 线环; 1e: 将 PDS 线在髌骨外侧面使用血管钳皮下分离, 经小切口引出, 剪断 PDS 线, 分别与另一骨道的 PDS 线打结, 还纳入至髌骨外缘; 1f: 2 条 PDS 的一端线分别与 1 个缝线束环打结, 牵拉 PDS 线, 将缝线环自一个骨道内侧口, 从另一个骨道内侧口引出; 1g: 每一骨道内侧口分别形成一个缝线环和另一骨道缝线环及线尾; 1h: 肌腱移植套入双线环中, 同时收紧两个线尾, 使肌腱与隧道紧密贴合, 收紧线环, 打结固定移植腱的髌骨侧。

Figure 1. A 18-year-old male. 1a: Preoperative MRI showed lateral subluxation of the right knee patella; 1b: Fluoroscopic location of the bone tunnel inlets for MPFL reconstruction; 1c: Two guide pins with tail holes were drilled from the medial patellar edge to other side, and then the shallow tunnels 5 mm in depth were created by a canulated drill 4.5 mm in diameter; 1d: Using guide pins to introduce a PDS suture ring was induced to the lateral side; 1e: The PDS suture exposed through a small lateral incision by separation subcutaneous with a mosquito clamp, cut the PDS loop, tied with the PDS of the other bone tunnel, and returned onto the lateral edge of the patella; 1f: One end of the two PDS was knotted with a suture band respectively, and pulled out the PDS to induce the suture loop from one medial inlet to the other one of the bone tunnel; 1g: The medial hole of each bone tunnel had a suture loop and a suture ends from loop in the other bone tunnel respectively; 1h: The tendon graft was inserted into the double wire loops in the middle part, and the two suture ends were pulled simultaneously to make the tendon closely fit the tunnels, and then the suture ends were tied to finish the patella side fixation of the graft tendon.

3 讨论

相关文献表明, 无论是否联合其他术式, MPFL 重建治疗髌骨脱位均能够改善膝关节功能, 降低髌骨再脱率^[10, 11]。而临床上重建 MPFL 的区别在于移植植物单双束及固定方式的选择上。双束重建相比于单束更符合原始 MPFL 的生物学形态, 且有着更强的抗拉力及更好的临床疗效^[12-14]。固定方式上, 股骨侧固定多采用界面挤压螺钉进行固定, 而髌骨侧固定则包括经骨隧道固定、界面螺钉固定、锚钉缝合固定及髌骨筋膜缝合固定。Kang 等^[4]通过荟萃分析比较了经骨隧道固定、缝线缝合固定以及带线锚钉固定重建 MPFL 的临床疗效, 发现 3 种术式无明显差异, 但经骨隧道术可通过腱骨愈合作用形成更强抗拔出出力, 且无锚钉置入, 减少异物反应。李庆军等^[15]采用横穿髌骨的双髌骨骨道技术解剖重建 MPFL 治疗髌骨脱位 37 例, 平均随访 30 个月, 取得良好临床疗效。而 Migliorini 等^[16]则通过系统分析比较了经骨隧道固定与带线锚钉固定重建 MPFL 的疗效, 两者虽能取得相似结果, 但经骨隧道有着更高的髌前区疼痛发生率。周超等^[17]也通过临床观察比较得出相同结论。对此, 作者认为经骨隧道较高的并发症发生率与隧道制作的粗细及长短有关。而短、小的隧道可更大程度降低该术式并发症发生率。

因此, 本文针对经骨隧道方式进行改良, 采用浅隧道双线环固定术重建 MPFL 治疗髌骨脱位, 能够很好地避免髌骨骨折及髌前区疼痛问题, 同时无内置物置入, 缩短了手术时间, 减轻排异反应, 也降低患者费用。术中使用带尾孔导针钻入髌骨, 便于将 PDS 线顺利引入髌骨中。而将 PDS 线替换为肌腱线作为引线是避免在引入另两根肌腱线时其强度不够而出现断线。另外在制作线环过程中, 对折的两根肌腱线应反向放置拉入隧道, 以保证双隧道各有一线环及线端。最后在放置肌腱过程中, 对折肌腱并同时收紧两线端再次进行打结, 从而形成双重固定, 使得肌腱完全嵌入浅隧道中, 利于腱骨愈合。

本研究纳入了 30 例患者, 术后膝关节屈伸活动度、VAS 评分、IKDC 评分、髌骨倾斜角以及适合角大小, 均显著改善, 提高了临床疗效。但本研究的不足之处: 纳入的样本量小, 缺乏随机对照研究以及不明确其远期疗效等, 故今后还需大样本、随机对照以及长期随访数据进行论证以及生物力学方面的研究。总之, 浅隧道双线环固定术重建 MPFL 治疗髌骨脱位

能明显提高临床疗效, 值得临床推广应用。

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