

# 经皮穿刺内侧副韧带深层松解技术在膝内侧半月板后角手术中的应用

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**【摘要】** 目的: 探讨采用经皮穿刺内侧副韧带深层松解技术对伴有内侧间室狭窄的膝内侧半月板后角撕裂患者的临床及影像学结果影响。方法: 自 2012 年 1 月至 2016 年 12 月, 采用经皮穿刺内侧副韧带深层松解技术治疗内侧半月板后角损伤患者 35 例, 男 21 例, 女 14 例; 年龄 21~55(39.1±6.5) 岁。MRI 测量术前及术后 24 个月半月板外凸程度; 膝关节外翻应力试验评估内侧副韧带稳定性并比较手术前后患侧-健侧的差值; 比较术前及术后 24 个月 Lysholm 评分和 IKDC 功能评分。结果: 所有患者获得随访, 时间 27~60(36.7±6.8) 个月。35 例患者均顺利完成手术, 伤口愈合良好, 无并发症发生。手术时间 0.5~1.2(0.8±0.4) h; 35 例患者中, 19 例行半月板部分切除术, 16 例行修复缝合术。术前半月板外凸(1.5±0.7) mm 与术后(1.7±0.4) mm 比较差异无统计学意义( $P>0.05$ )。Lysholm 评分由术前的(53.4±8.8)分提高至术后 24 个月的(91.5±4.6)分, 差异有统计学意义( $P<0.05$ ); IKDC 评分由术前的(50.7±9.2)分提高至术后 24 个月(90.6±3.9)分, 差异有统计学意义( $P<0.05$ ); 患侧膝关节在 0°位和屈膝 30°位接受外翻应力试验测试并与健侧对比, 全部患者均为阴性。结论: 对于存在膝关节内侧间室狭窄的内侧半月板后角撕裂患者, 膝关节镜下采用经皮穿刺内侧副韧带深层松解技术能够改善内侧间室操作空间, 并且不产生膝外翻松弛和半月板外凸。

**【关键词】** 内侧副韧带; 膝; 半月板; 关节囊松解; 关节穿刺术

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**Application of percutaneous pie-crusting deep medial collateral ligament release for posterior horn surgery of medial meniscus** HUANG Bing-zhe, YU Hai-chi, LI Ying-zhi, QU Cheng-yuan, GUO De-ming, WANG Ya-xiong, and LIU Xiao-ning. Orthopaedic Medical Center, the 2nd Hospital of Jilin University, Changchun 130041, Jilin, China

**ABSTRACT Objective:** To explore clinical and radiographic effects of percutaneous pie-crusting deep medial collateral ligament release in patients with posterior horn tear of medial meniscus combined with tight medial compartment. **Methods:** From January 2012 to December 2016, 35 patients with medial meniscus posterior horn injury were treated with percutaneous pie-crusting deep medial collateral ligament release technique, including 21 males and 14 females, aged from 21 to 55 years old with an average of (39.1±6.5) years old. Degree of meniscus extrusion were recorded before and 24 months after operation. The knee valgus stress test was performed to evaluate stability of medial collateral ligament, and compared difference between healthy and affected side. Lysholm and IKDC functional scores were compared before and 24 months after operation. **Results:** All patients were followed up from 27 to 60 months with an average of (36.7±6.8) months. All patients were underwent operation, the wound healed well without complications. Operative time ranged from 0.5 to 1.2 h with an average of (0.8±0.4) h. Nineteen patients were performed partial meniscectomy, 16 patients were performed repair suture. Convex of meniscus before operation was (1.5±0.7) mm, and (1.7±0.4) mm after operation; had no statistical difference ( $P>0.05$ ). Lysholm score was improved from 53.4±8.8 before operation to 91.5±4.6 at 24 months after operation; IKDC score was increased from 50.7±9.2 before operation to 90.6±3.9 at 24 months after operation; there was statistically significant ( $P<0.05$ ). Valgus stress test was performed on 0° and 30° position of knee flexion in affected side and compared with ipsilateral side, all patients showed negative. **Conclusion:** For patients with medial meniscus tear of posterior horn combined with tight medial compartment, percutaneous pie-crusting deep medial collateral ligament release could improve medial compartment space, and Knee valgus instability and meniscus extrusion are not affected.

**KEYWORDS** Medial collateral ligament, knee; Meniscus; Joint capsule release; Arthrocentesis

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内侧半月板后角撕裂的发病率较高,也是常见的膝关节镜手术指征之一<sup>[1]</sup>。对于内侧半月板后角的处理,视野和空间是影响手术顺利进行并减少医源性并发症的主要因素。既往关于内侧半月板后角撕裂的文献报道中,由于内侧间室术野狭窄造成的半月板撕裂漏诊或者因进入手术工具造成医源性软骨损伤以及膝关节强力外翻造成内侧副韧带撕裂的病例并不罕见<sup>[2]</sup>。对于大部分存在膝关节内侧间室狭窄的内侧半月板后角撕裂患者,Lyu 等<sup>[3]</sup>采用经皮穿刺内侧副韧带深层松解技术能够获得足够的内侧间室操作空间,然而术后 1 个月时,部分患者出现关节不稳感。目前关于该技术的远期临床结果报道并不多见,Fakioglu 等<sup>[4]</sup>报道医源性松弛在 3 个月内恢复,这可能间接表明受损的内侧副韧带成功愈合,然而膝关节长期稳定性特别是内侧副韧带功能评价缺乏长期随访。本研究回顾性分析了自 2012 年 1 月至 2016 年 12 月采用该技术治疗的 35 例伴有内侧间室狭窄的内侧半月板后角撕裂患者的临床资料,现报告如下。

## 1 资料与方法

### 1.1 病例选择

纳入标准:确诊为膝关节内侧半月板后角撕裂,伴有内侧间室狭窄;采用经皮穿刺内侧副韧带深层松解技术;半月板后角损伤接受全内缝合修复或部分切除;资料完整,随访时间>2 年。排除标准:合并膝关节韧带损伤;既往膝关节手术者;合并膝关节骨折者;双膝半月板损伤者;膝关节 Kellgren-Lawrence 分级<sup>[5]</sup>3~4 级;随访时间<2 年。

### 1.2 临床资料

本组 35 例,其中男 21 例,女 14 例;年龄 21~55 (39.1±6.5) 岁;病程 2~14 (6.4±3.1) 个月;其中运动损伤 21 例,扭伤 14 例。主要临床症状表现为膝关节疼痛、肿胀、交索感及深蹲痛,上述症状予非甾体抗炎药及理疗后缓解不理想。

### 1.3 治疗方法

采用腰-硬联合麻醉,患者取仰卧位。常规消毒,铺无菌中单,首先在髌腱外缘 0.5 cm 膝关节软点处建立前外侧入路插入关节镜镜头,行诊断性关节镜检查,依次检查髌上囊、内侧沟、外侧沟、外侧半月板、内侧半月板、前交叉韧带、后交叉韧带。根据内侧半月板后角病变位置直视下用 18 G 硬膜外针头辅助建立前内侧入路,使用刨刀清理滑膜组织后,用探钩再次检查内侧半月板病变位置及撕裂情况。经皮穿刺内侧副韧带深层松解技术具体手术方法如下:本组患者在关节弯曲 30°并且手动施加外翻应力时,探钩检查内侧间隙的最窄部分小于探钩尖宽度约

5 mm,无法完整检查整个内侧半月板后角明确撕裂形态,亦无法进入关节镜器械以完成相关操作。内侧副韧带深层松解过程在关节镜直视下完成,关节镜进入膝关节内侧间室,通过皮肤透光区识别隐神经和隐静脉后,18 G 硬膜外针头标记膝内侧副韧带后 1/3 和内侧半月板表面以上区域,采用由外向内技术平行于内侧副韧带纤维走行方向仔细穿刺后方内侧副韧带关节囊复合体 2~4 次,直到听到或感觉到拉伸声,并且看到内侧关节间隙张开到能够完整显露内侧半月板后角的结构和撕裂范围,镜下完成相关半月板操作没有困难。对于具备缝合条件位于红区的纵裂,新鲜化断端后用 Fast-Fix 间隔 5 mm 行垂直褥式或者环形缝合;对于不适合行半月板修复的患者,交替使用刨刀及蓝钳行半月板部分切除,直到撕裂断端边缘稳定。

所有患者佩戴膝关节铰链支具 6 周,术后第 1 天开始进行踝泵及直腿抬高练习,术后 6 周全负重;行半月板修复缝合患者术后 6 周避免深蹲,3 个月内深蹲不超过 120°。

### 1.4 观察项目与方法

**1.4.1 影像学指标** 手术前后行膝关节 MRI 检查,对内侧半月板外凸程度进行测量(图 1)。

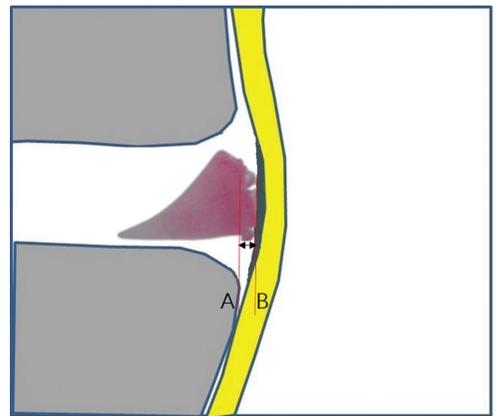
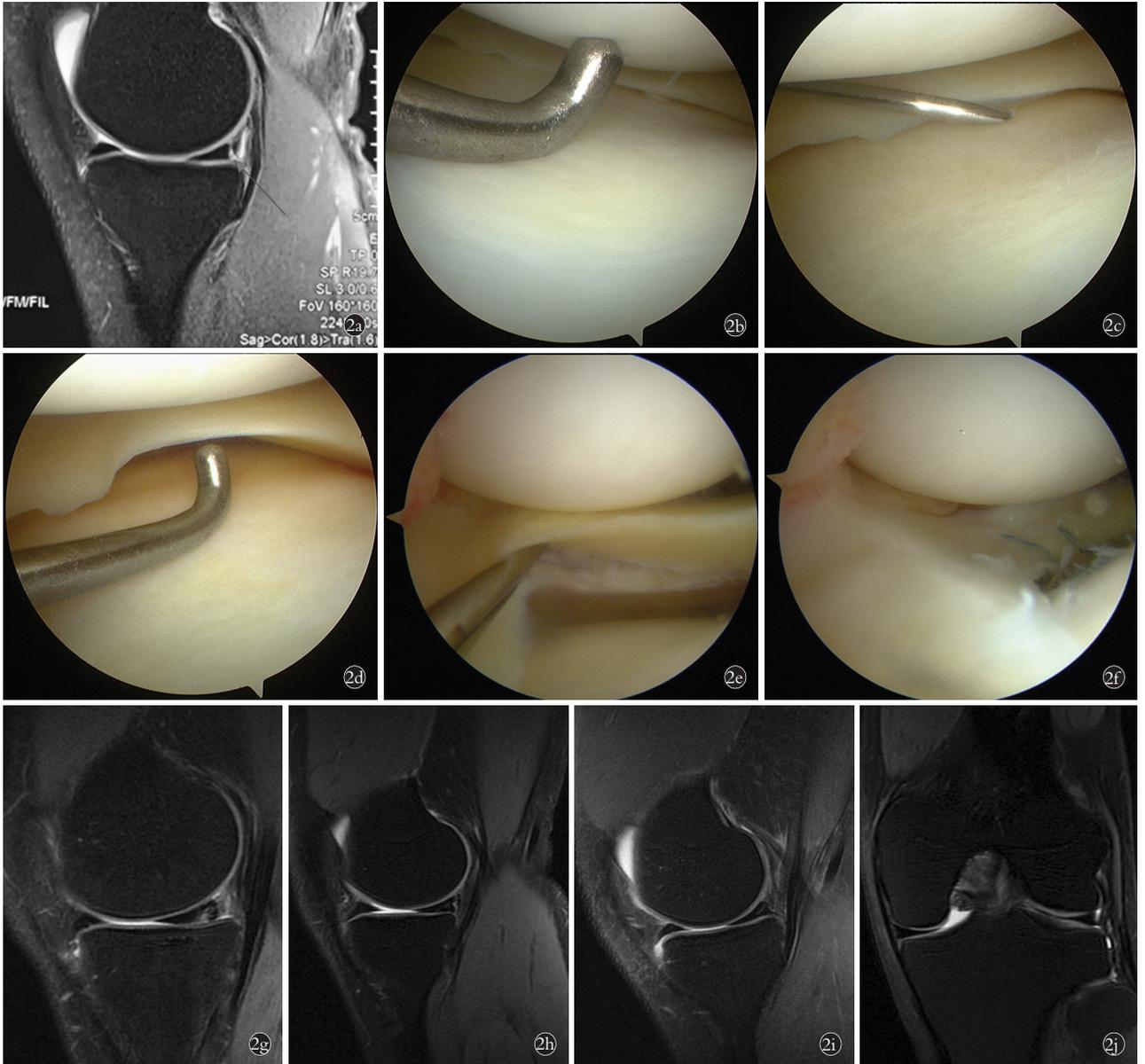


图 1 内侧半月板外凸程度测量示意图 选择膝冠状位核磁最中央层面,垂直于关节面分别于内侧胫骨平台后缘及内侧半月板后缘引两条垂线,二者之间距离为半月板外凸量化值

**Fig.1** Schematic diagram of measurement of meniscus extrusion the most central level of coronal knee MRI,two parallel lines was drawn perpendicular to articular surface at the posterior edge of medial tibial plateau and posterior margin of medial meniscus,the distance between the two lines is a meniscus extrusion value

**1.4.2 临床疗效** 手术前后采用 Lysholm 评分<sup>[6]</sup>,IKDC 评分<sup>[6]</sup>对其临床疗效进行评价。Lysholm 评分满分为 100 分,包括跛行、支撑、交锁、疼痛、关节不稳、肿胀、上楼、下蹲。IKDC 评分满分为 100 分,包括





**图 2** 患者,男,24 岁,左膝内侧半月板撕裂 2 个月 **2a.** 术前 MRI 示内侧半月板后角纵裂(箭头) **2b.** 膝外翻关节镜检查示内侧间室狭窄,开口小于探针尖宽度 **2c.** 术中采用由外向内经皮穿刺内侧副韧带深层松解技术,见 18 G 硬膜外针头穿过内侧副韧带深层进入关节腔 **2d.** 经皮穿刺内侧副韧带深层松解后即刻关节镜检查示内侧间室开口良好,探针操作空间宽敞 **2e.** 内侧关节间隙张开到能够完整显露内侧半月板后角的结构和撕裂范围 **2f.** 术后即刻关节镜检查示后内侧半月板修复 **2g.** 术后 3 个月矢状位 MRI 示内侧半月板后角修复区域高信号水肿带 **2h.** 术后 12 个月矢状位 MRI 示内侧半月板后角修复区域线性高信号区域贯通下表面,提示不完全愈合 **2i.** 术后 24 个月矢状位 MRI 示内侧半月板后角修复区域线性高信号区域,考虑瘢痕修复所致 **2j.** 术后 24 个月冠状位 MRI 示内侧半月板无外凸

**Fig.2** Male, 24 years old, medial meniscus tear of left knee for 2 months **2a.** Preoperative MRI showed posterior longitudinal tear of medial meniscus (arrow) **2b.** Knee arthroscopy showed median knee space was narrow and the opening was smaller than the width of probe tip under valgus stress **2c.** Application of outside-in percutaneous pie-crusting deep medial collateral ligament release with the 18 G epidural needle penetrated the deep medial collateral ligament into joint cavity **2d.** Arthroscopic examination showed medial compartment opening was optimal and the working space for the probe was spacious immediately after application of percutaneous pie-crusting deep medial collateral ligament release **2e.** The medial joint space was wide enough to completely reveal the posterior horn of medial meniscus **2f.** Immediate postoperative arthroscopy showed meniscus repair **2g.** Postoperative MRI on sagittal view at 3 months showed high signal zone on posterior meniscus repair area **2h.** Postoperative MRI on sagittal view at 12 months showed a linear high-signal zone penetrating the inferior surface of medial meniscus, suggesting incomplete healing **2i.** Postoperative MRI on sagittal view at 24 months showed a linear high-signal zone on the body of medial meniscus, suggesting scar repair **2j.** Postoperative MRI on coronal view at 24 months showed no meniscus extrusion of medial meniscus

等工具的操作空间,有效避免医源性软骨损伤发生。

### 3.2 经皮穿刺内侧副韧带深层松解技术操作技巧

生物力学研究表明,膝关节伸展时在外翻应力加载过程中,内侧副韧带最大张力应变发生在内侧副韧带深层后部靠近关节线的位置<sup>[9]</sup>。因此,该区域是关节镜手术中施加外翻力后影响膝内侧间隙增加的主要限制因素。经皮穿刺内侧副韧带深层松解技术的主要目的是经皮扩大内侧关节间隙,通过皮肤透光区识别隐神经和隐静脉后,在膝关节施加外翻应力时平行于内侧副韧带纤维走行方向仔细穿刺后方内侧副韧带深层组织 2~4 次,直到听到或感觉到拉伸声,并且看到内侧关节间隙扩大到理想的程度。在本组病例中,在施加手动外翻应力的同时,松解紧邻关节间隙内侧副韧带深层后 1/3 能显著增加视野,此外,内侧关节间隙张开程度的关节镜可视化操作让每个单一手术需要的松解程度变得可控,能够有效避免内侧副韧带撕裂发生。

### 3.3 经皮穿刺内侧副韧带深层松解技术对膝关节稳定性影响

膝关节外翻不稳定是经皮穿刺内侧副韧带深层松解技术主要的忧虑,本研究患者术前及末次随访时膝关节侧方应力试验均为阴性。此外,本研究在术前及末次随访时半月板外凸程度比较差异无统计学意义,证实了和健侧相比经皮穿刺内侧副韧带深层松解技术的应用并未导致膝关节外翻不稳定,同样也未造成半月板外凸增加。笔者把经皮穿刺内侧副韧带深层松解技术对膝关节远期稳定性无明显影响的原因归为以下几点:(1)内侧副韧带浅层是膝内侧主要稳定结构,解剖结构上膝关节内侧副韧带深层结构与内侧半月板紧密相连,本项技术主要采用针头对内侧副韧带深层反复穿刺,并在关节镜监视下完成松解全过程,不影响内侧副韧带浅层完整性。(2)在当前研究中应用的经皮穿刺内侧副韧带深层松解技术造成的内侧副韧带损伤可归类为 I 级或 II 级损伤,其已在 Fakioglu 等<sup>[4]</sup>的研究中得到证实。(3)由于血供良好,内侧副韧带损伤具有良好的治愈潜力,大多数 I 级和 II 级损伤通过支具使用 2~6 周能够实现愈合<sup>[10]</sup>。

### 3.4 本研究的局限性

本研究的不足之处如下:本研究是一项回顾性对照研究,存在一定的选择偏倚,仍需要进一步采用回顾性队列研究或前瞻性研究,并且与未采用该技术的病例进行对照,进一步证实该手术技术的有效性;本组患者随访时间为 27~60 个月,对术后 5 年以

上的膝关节稳定性及半月板外凸程度需进一步观察;本研究病例数相对较少,需要进一步积累病例。

对于存在膝关节内侧间室狭窄的内侧半月板后角撕裂患者,膝关节镜下应用经皮穿刺内侧副韧带深层松解技术能够改善内侧间室操作空间,并且在术后随访时不产生膝外翻松弛和半月板外凸。

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