

# 滑移截骨在关节外畸形全膝关节置换中的应用

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**【摘要】** 目的: 针对伴有复杂股骨关节外畸形导致的严重膝骨性关节炎、内翻膝患者在进行全膝关节置换手术时施行滑移截骨技术达到内外侧软组织平衡, 观察其临床疗效。方法: 自 2014 年 6 月至 2018 年 1 月共收治 22 例伴有复杂股骨关节外畸形的重度膝骨性关节炎患者, 施行全膝关节置换手术。男 5 例, 女 17 例; 年龄 48~76(61.3±13.8) 岁。均为内翻畸形, 由股骨关节外畸形所导致。术前测量髌膝踝角(hip-knee-ankle, HKA)角(158.8±9.7)°, 膝关节学会评分系统(Knee Society score, KSS)临床评分(32.6±6.1)分, 功能评分(35.8±9.6)分, 美国特种外科医院(Hospital for Special Surgical, HSS)评分(39.7±4.6)分。术前膝关节活动度(80.6±10.7)°。在关节置换时均采用机械对线法, 先平衡屈曲间隙, 冠状面的不平衡均采用内侧股骨髁行冠状面垂直上下滑移截骨, 伸直间隙内外侧的差距决定截骨块滑移的距离, 直至间隙平衡。以数枚螺钉固定截骨块后按常规安装假体。结果: 所有患者伤口 I 期愈合, 无伤口并发症发生。22 例均获随访, 时间 18~36(28.2±10.1) 个月。拍 X 线片见截骨块骨折线消失时间 2~5(3.5±1.5) 个月, 无骨不愈合发生; 末次随访测量 HKA 角(178.8±0.7)°, 较术前提高; HSS 评分(91.3±6.0)分, KSS 临床评分(93.7±3.5)分, KSS 功能评分(81.2±6.5)分, 膝关节活动度(121.7±11.6)°, 均较术前改善。结论: 针对伴有复杂股骨关节外畸形的严重膝骨性关节炎患者施行滑移截骨, 内翻畸形严重者向下滑移股骨内髁, 手术相对简单、损伤小, 易于达到屈伸间隙内外侧软组织平衡, 短期临床疗效满意。

**【关键词】** 关节成形术, 置换, 膝; 骨关节炎, 膝; 截骨术

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**Application of sliding osteotomy in total knee arthroplasty for patients with extra-articular femoral deformity** QING Zhong, YE Jiu-min, MA Jian-bing, and ZHI Li-qiang. Honghui Hospital, Xi'an Jiaotong University, Xi'an 710054, Shaanxi, China

**ABSTRACT Objective:** In order to observe the clinical effects of sliding osteotomy for patients with severe knee osteoarthritis and varus knee due to complex femoral extra-articular deformity to achieve the medial and lateral soft tissue balancing during total knee arthroplasty. **Methods:** From June 2014 to January 2018, a total of 22 patients with severe knee osteoarthritis and complex extra-articular malformation of femurs were treated with total knee arthroplasty. There were 5 males and 17 females in this group, aged 48 to 76 years old, with an average age of (61.3±13.8) years old. All the patients had varus deformities caused by extra-articular deformities of femur. Hip-knee-ankle (HKA) angle was (158.8±9.7)° before operation, and the average Knee Society Score (KSS) clinical score was 32.6±6.1; KSS function score was 35.8±9.6; the average Hospital for Special Surgical (HSS) score was 39.7±4.6; the average range of motion before operation was (80.6±10.7)°. The mechanical alignment method was used in joint replacement. The flexion space was balanced first. The coronal plane vertical sliding osteotomy was performed on the medial femoral condyle for the imbalance of coronal plane. The sliding distance of the osteotomy block was determined by straightening the gap between the inner and outer sides of the space until the space was balanced. After the separated segments were fixed with several screws, the prosthesis was installed as usual. **Results:** The wounds of all patients healed in the first stage, and no wound complications occurred. All the 22 patients were followed up, and the duration ranged from 18 months to 3 years with an average of (28.2±10.1) months. X-ray showed that the fracture line disappeared for 2 to 5 (3.5±1.5) months without nonunion. HKA angle measured at the latest follow-up was (178.8±0.7)°, which was significantly different from that before operation. The HSS score was 91.3±6.0; KSS clinical score 93.7±3.5; KSS functional score 81.2±6.5; and the average range of motion of knee joint was (121.7±11.6)°, which was statistically significant compared with that before operation. **Conclusion:** For severe knee osteoarthritis patients with complex femoral extra-articular deformity, sliding osteotomy is performed. For severe varus deformity, downward sliding the medial femoral condyle is performed. The operation is relatively simple and the damage is small. It is easy to achieve the balance of internal and external soft tissue in flexion extension space. The short-

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term clinical effect is satisfactory.

**KEYWORDS** Arthroplasty, replacement, knee; Osteoarthritis, knee; Osteotomy

目前,全膝关节置换术(total knee arthroplasty, TKA)用于治疗晚期膝关节疾病能够矫正畸形、消除疼痛、恢复力线及活动度,疗效满意。TKA 成功的关键在于恢复正常的力线,获得正常的屈伸状态下的软组织平衡。大多数畸形不严重的膝关节疾病施行 TKA 过程中,正常截骨后只需稍加松解紧张或挛缩的软组织即可获得平衡<sup>[1-4]</sup>。然而,对于伴有复杂股骨关节外畸形的严重膝骨性关节炎的患者,如何在 TKA 中获得满意的力线的同时又易于达到软组织平衡,有时术中确实难以抉择。针对伴有复杂关节外畸形的严重膝骨性关节炎内翻膝畸形患者施行滑移截骨,早期疗效满意,报告如下。

## 1 资料与方法

### 1.1 一般资料

纳入本科自 2014 年 6 月至 2018 年 1 月收治的 22 例伴有复杂关节外畸形的重度膝骨性关节炎患者,计划施行全膝关节置换手术。纳入标准:(1)所有患者为内翻畸形,伴有股骨侧关节外畸形。(2)均经过规范化保守治疗,至后期保守治疗无效、重度疼痛并活动受限。(3)影像表现提示膝关节重度退变,关节间隙消失。(4)所有患者的畸形为冠状位单平面畸形。排除标准:(1)合并严重内科疾病。(2)合并胫骨侧骨性畸形。(3)股骨侧同时伴有严重的矢状位和旋转畸形。(4)患者膝关节畸形来自于关节内。(5)合并重度骨质疏松者。

本组男 5 例,女 17 例;年龄 48~76(61.3±13.8)岁。全部为内翻畸形。入院后完善常规检查,拍摄患侧膝关节标准正侧位 X 线片、双下肢全长位 X 线片,所有患者明确有明显关节外畸形,术前测量髁膝踝角(hip-knee-ankle angle, HKA)(158.8±9.7)°。按临床内翻程度分级(轻度<15°,中度 15°~30°,重度>30°),本组患者均为中重度。分别按照膝关节学会评分系统(Knee Society score, KSS)<sup>[5]</sup>,美国特种外科医院(Hospital for Special Surgical, HSS)评分进行疗效评价<sup>[6]</sup>。术前 KSS 临床评分(32.6±6.1)分, KSS 功能评分(35.8±9.6)分, HSS 评分(39.7±4.6)分。术前活动度(80.6±10.7)°。

### 1.2 治疗方法

手术由同一组医生完成。采用全身或硬腰麻醉,气囊止血带控制下手术。均采用膝关节正中纵切口,髁旁内侧入路逐层切开。首先进行股骨远端截骨:在关节置换时均采用机械对线法、股骨髓内定位,按照术前计划进行股骨远端第 1 刀截骨,然后垂直于胫骨机械轴行胫骨近端截骨,截骨厚度 8~10 mm。随

后,切除交叉韧带、内外侧残余半月板,清理关节周围明显增生的骨赘,内翻畸形松解内侧软组织主要为内侧副韧带深层、浅层,屈曲挛缩严重者松解膝关节后关节囊、半膜肌腱,松解方法均为骨膜下剥离。此时,以间隙平衡法施行股骨后髁截骨,以取得屈曲间隙的平衡。因存在关节外畸形,因此,此步骤完成后所有患者伸直位仍残留内外侧不平衡:因内翻者内侧软组织挛缩,外侧软组织被拉伸,相对松弛,截骨完成后冠状位伸直间隙内侧间隙小而外侧间隙大。此时,采取内侧股骨髁滑移截骨:将内侧副韧带附着的股骨内髁骨块截下,厚度保留 0.5 cm 以上,截骨完成后将股骨内侧截骨块连同内侧副韧带向远端滑移,以使内侧间室增大。

滑移截骨具体步骤:安装试模,伸直位行侧方应力试验评估并以游标卡尺测量内外侧间隙的差距,以此作为滑移截骨所需移动的距离。股骨假体尽量偏外侧放置,内侧滑移截骨块厚度至少应保留 0.5 cm 以上,保证骨块的厚度和强度以便内固定,同时保证内侧副韧带的完整附着。按照之前所测量的内外侧间隙差距以电刀标记,用摆锯截除股骨内髁,保持骨膜的连续性,垂直向上或向下滑移截骨块直至所需高度,所截在前后位置上没有任何位移。钻孔,以 4~5 枚 40~50 mm 长 3.5 松质骨螺钉斜向上方固定截骨块。向下滑移骨块悬垂于假体边缘外侧多余骨质予以清除,以避免对韧带和聚乙烯衬垫的刺激、磨损。脉冲冲洗术野后安装假体。术毕,置引流管后关闭伤口。

本组患者除 1 例伴有严重关节内畸形,胫骨外侧平台骨缺损,使用金属垫块和延长杆外,其余均采用普通假体。

术后常规抗感染、抗凝治疗,24~48 h 内拔除引流管,返回病房后即开始进行股四头肌肌力锻炼和膝关节屈伸锻炼。所有患者在侧方稳定性支具保护下活动患肢,拔除引流管即完全下地负重行走。支具保护时间为 6 周。

### 1.3 观察项目与方法

术前术后常规拍摄膝关节正侧位 X 线片和双下肢全长 X 线片,测量 HKA 并与术前比较,进行 KSS、HSS 评分;记录并比较术前术后活动度。

### 1.4 统计学处理

采用 SPSS 19.0 统计软件进行分析。定量资料数据以均数±标准差( $\bar{x} \pm s$ )表示,同组患者术前术后自身对照,采用配对设计定量资料的 *t* 检验;定性资料采用  $\chi^2$  检验。以  $P < 0.05$  为差异有统计学意义。

2 结果

术后所有患者伤口 I 期愈合, 无伤口并发症发生。3 例术后超声检查发现下肢深静脉血栓, 均 < 0.6 cm, 予以加大抗凝治疗强度后血栓均在 2 周内消失。22 例均获随访, 时间 18~36(28.2±10.1)个月。摄 X 线片见截骨块骨折线消失时间 2~5(3.5±1.5)个月, 无骨不愈合发生。末次随访 HKA(178.8±0.7)°, 较术前提高; HSS 评分(91.3±6.0)分, KSS 临床评分(93.7±3.5)分, KSS 功能评分(81.2±6.5)分, 膝关节活动度(121.7±11.6)°, 均较术前改善, 见表 1, 2。典型病例图片见图 1。

3 讨论

3.1 TKA 的软组织松解策略

TKA 作为针对晚期重度骨性关节炎患者的治疗手段, 能有效减轻疼痛、矫正畸形, 恢复正常膝关节功能, 显著提高生活质量<sup>[6-7]</sup>。

TKA 获得满意疗效的关键是力线恢复和内外侧软组织平衡满意。在恢复下肢力线方面, TKA 最常用的方法是机械对线法, 即尽可能恢复下肢力线至髌膝踝关节中心三点一线。对于无明显畸形的或者仅仅是关节内畸形的患者, 利用机械对线法截骨后, 仅需对挛缩的软组织进行少量的松解即可获得满意的

表 1 伴有复杂关节外畸形的重度膝骨性关节炎患者 22 例术前术后 HSS 评分比较( $\bar{x}\pm s$ , 分)

Tab.1 Comparison of HSS scores of patients with severe knee osteoarthritis with complex extraarticular deformities before and after operation( $\bar{x}\pm s$ , score)

时间	疼痛	功能	活动度	肌力	屈曲畸形	稳定性	总分
术前	7.43±2.95	6.85±2.61	6.62±1.28	7.82±2.63	3.25±2.31	3.43±1.17	37.21±6.38
末次随访	28.90±5.88	20.20±2.05	12.26±1.52	8.82±0.97	9.01±0.81	9.13±0.54	88.73±9.48
t 值	29.665	21.820	24.653	2.089	16.372	32.054	38.269
P 值	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

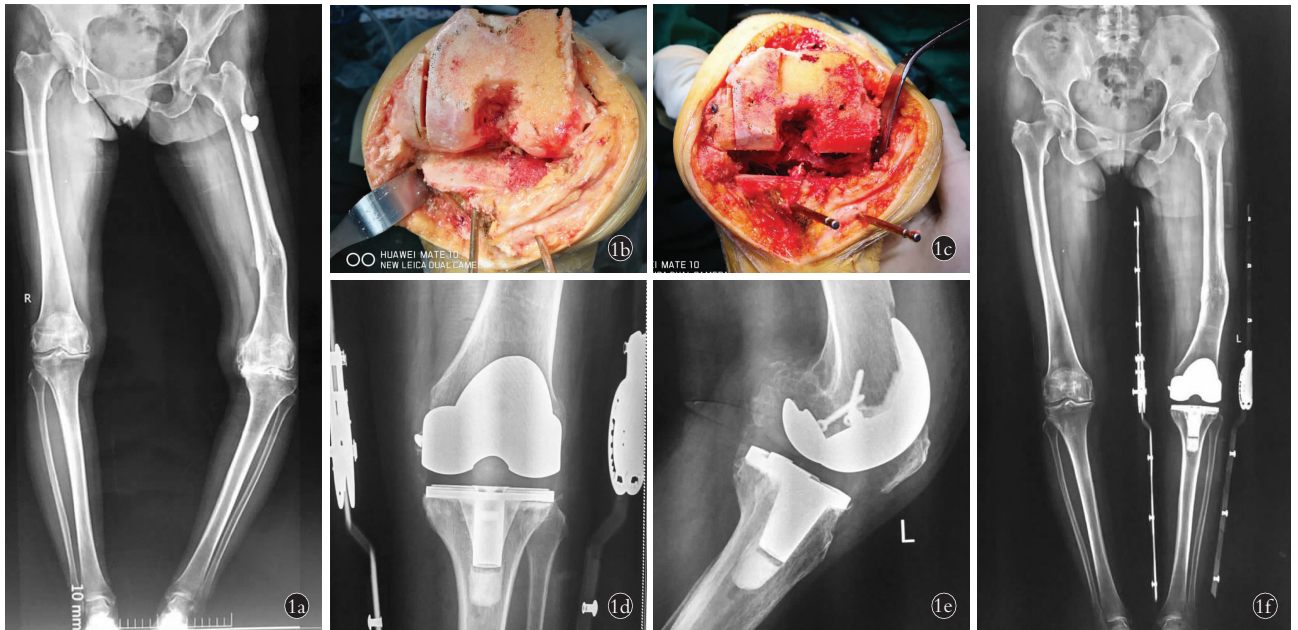


图 1 患者,女,62 岁,左膝骨性关节炎,左膝内翻畸形 1a. 术前 X 线片示左膝关节内翻 40°, 屈曲挛缩 30° 1b. 术前计划按股骨胫骨分别按各自机械轴进行截骨, 截骨完成后膝关节内外侧间隙差距巨大 1c. 术中因股骨畸形, 严重内翻, 按常规置入截骨器械进行股骨远端截骨, 股骨远端外侧正常截骨, 内侧截骨量少 1d, 1e. 术后即刻左膝正侧位 X 线片示股骨假体位置及下肢力线恢复满意, 滑移截骨块固定牢固 1f. 术后即刻双下肢站立位全长 X 线片示左下肢力线恢复正常

Fig.1 Female, 62-year-old, left knee osteoarthritis, varus deformity 1a. Preoperative X-ray showed 40° varus and 30° flexion contracture 1b. According to preoperative plan, osteotomy was carried out according to the respective mechanical axis of femur and tibia. After osteotomy, there was a huge gap between the medial and lateral space of knee joint 1c. Because of the deformity of femur and severe varus during the operation, the osteotomy of distal femur was performed with conventional osteotomy instruments. The lateral osteotomy of distal femur was normal, and the amount of medial osteotomy was small 1d, 1e. Immediately after operation, AP and lateral X-ray films of the left knee showed that the position of femoral prosthesis and the lower limb line of force recovered satisfactorily, and the separated segments after sliding was firmly fixed 1f. Immediately after operation, the full length X-ray film showed that the strength line of the left lower limb returned to normal

表 2 伴有复杂关节外畸形的重度膝骨性关节炎患者 22 例术前术后各项指标比较 ( $\bar{x} \pm s$ )

Tab.2 Comparison of indexes of patients with severe knee osteoarthritis with complex extraarticular deformities before and after operation ( $\bar{x} \pm s$ )

时间	HKA(°)	HSS 评分(分)	KSS 临床评分(分)	KSS 功能评分(分)	膝关节活动度(°)
术前	158.8±9.7	39.7±4.6	32.6±6.1	35.8±9.6	80.6±10.7
末次随访	178.8±0.7	91.3±6.0	93.7±3.5	81.2±6.5	121.7±11.6
t 值	15.380	-23.896	-37.621	-26.330	-2.100
P 值	<0.001	<0.001	<0.001	<0.001	<0.001

力线和软组织平衡。对于内翻畸形的膝关节,松解的办法主要为对内侧副韧带(包括深浅层)骨膜下剥离,或者针刺法(pie-crusting)进行松解<sup>[3,8]</sup>。但这两种方法有其明显的局限性。前者松解后对于间隙伸展的空间有限,后者易于造成韧带不可逆的撕裂或者断裂,此情况发生后只能采用限制性假体以获得间隙的相对平衡和稳定,有学者也直接选用限制性假体通过增加限制性获得平衡<sup>[9-10]</sup>。即便是没有关节外畸形的患者,伴有严重内外翻畸形的,Eng<sup>[11]</sup>认为很难通过直接松解的办法获得软组织平衡,也采用滑移截骨技术。因此,对于合并有严重的股骨关节外畸形者如何矫正下肢力线至 HKA 三点一线理想力线同时又能获得满意的软组织平衡,尚有诸多争议。

### 3.2 合并畸形的 TKA 矫形策略

多数学者主张畸形存在于哪里就在哪里矫正,关节外畸形于关节外矫正,然后再 I 期或 II 期行 TKA。这样的好处在于于畸形处截骨矫正后再行 TKA 易于使下肢力线达到理想力线,软组织松解范围及程度明显较少,利于保护软组织,手术难度大大降低<sup>[12]</sup>。但是,此类患者多为老年患者,身体情况较差。如果行截骨加全膝关节置换,相当于 2 个手术,手术时间延长,出血量增大,康复时间延长;畸形部位常位于骨干部位,此处截骨后截骨愈合时间长,常发生畸形愈合、延迟愈合甚至不愈合等现象。考虑到这些情况,手术后不宜让患者很快就下地完全负重行走,因此是不利于患者康复的<sup>[13]</sup>。

另有学者主张对于伴有股骨关节外畸形者直接在关节置换时于关节内矫正:按照股骨机械轴进行截骨,然后于关节凹侧松解相应软组织直至内外侧软组织达到平衡<sup>[14-17]</sup>。如果内外翻畸形严重,要想达到畸形完全矫正比较困难,可于股骨侧残留部分内外翻畸形,不影响疗效和假体长期生存率。因软组织松解范围和能达到的拉长程度有限,对于畸形严重的患者,采取此办法将面临极大的软组织松解压力,有时甚至因松解不慎导致内外侧副韧带的断裂。

### 3.3 股骨髁滑移截骨的优势

考虑到此情况,有学者提出使用股骨髁滑移截

骨技术将股骨髁截骨连同内侧或者外侧副韧带止点上移或下移以平衡膝关节屈伸间隙<sup>[18-19]</sup>。此技术对于伴有复杂股骨关节外畸形的严重膝骨性关节炎,既能实现完美达到理想下肢机械力线;又能有效保持内外侧副韧带等重要软组织的完整性,可将关节外畸形转移至关节内一并解决。此技术的优良特性在严重外翻膝中的应用已经得到很好的证实<sup>[20]</sup>。股骨髁滑移截骨部位是在血运丰富的松质骨区域,截骨部位接触面积大。而如果在关节外矫正畸形,往往是骨干部位,骨干部位的愈合相对时间比较长,不愈合的概率相对较大。二者比较,股骨髁滑移截骨不愈合可能性大大降低。此外,滑移截骨全膝置换后的患者可以和普通全膝置换一样于手术当天或第 2 天下地正常行走,仅需侧方支具保护即可,因此康复锻炼、负重行走等同于普通全膝关节置换患者,能达到很好的锻炼效果。

### 3.4 操作要点

(1) 在术前查体时一定要明确患侧膝关节内外侧副韧带结构和功能的完整性,必要时手术中准备侧方稳定限制性假体以防万一。(2) 因滑移截骨有可能会增大关节间隙并因此发生关节线的改变,手术中初步截骨时应倾向保守。(3) 按照术前测量的截骨角度进行股骨远端和胫骨近端截骨,股骨远端、胫骨近端截骨完成后清除周围骨赘,松解软组织。(4) 间隙平衡法截除股骨后髁骨质取得屈曲间隙平衡,测量内外侧间隙差距,按照此差距决定滑移截骨距离。(5) 滑移截骨块至少保留 5 mm 左右骨质,螺钉牢固固定。骨质疏松患者慎用。

本组患者全部采取的是股骨内髁滑移截骨,因本组患者均是内翻者,因此需要将截骨块向下滑移以增大内侧间隙。其原因是笔者认为内侧韧带结构相对简单,内侧副韧带深层、浅层走行方向大致一致,伸直、屈曲间隙均是由二者决定,只是屈伸到不同角度不同束紧张性不同而已,滑移后对于间隙空间的变化相对容易控制和掌握,朝向同一个方向滑移也只是会增加一个方向的空间。而外侧结构截然不同,髂胫束、外侧副韧带、腓肌腱、股二头肌腱,腓

斜韧带;伸直紧张性由髂胫束、外侧副韧带、腓肌腱决定,屈曲稳定性由外侧副韧带、腓肌腱决定。外侧股骨髁的滑移截骨因该截骨块上同时附着好几种结构,既有影响伸直间隙的,也有影响屈曲间隙的,因此,理论上即便是向一个方向移动,也会同时影响屈曲和伸直间隙。考虑到这些因素,笔者采用的是附着结构相对简单的内侧股骨髁滑移截骨。

本研究不足之处在于:此类复杂股骨外畸形病例数量相对较少,术后观察随访时间相对较短,需长时间追踪随访此类患者的术后疗效,才能得出更令人信服的临床结果。

综上所述,对于关节外畸形导致的严重内翻畸形,尤其是年龄较大的患者,Ⅰ期行全膝关节置换,采用股骨内髁滑移截骨技术,创伤小,可避免大范围软组织松解导致的膝关节不稳定,骨愈合并发症发生率,可以获得满意的膝关节稳定性和功能,早期效果满意,但其远期效果尚需进一步观察。

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