

· 临床研究 ·

术中残留一定程度屈曲畸形对TKA疗效的影响

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[摘要] 目的: 探讨全膝关节置换术(total knee arthroplasty, TKA)治疗伴有严重屈曲畸形(flexion deformity, FD)的膝关节骨关节炎, 术中残留一定程度FD对疗效的影响。方法: 回顾性分析南京医科大学第一附属医院2013年10月—2017年9月间按完全矫正FD($<5^\circ$)理念治疗的52例伴有严重FD($>30^\circ$)的患者, 称为术中完全伸直组(52例), 以及2017年10月—2021年9月间按可以适当残留一定程度FD($5^\circ\sim 10^\circ$)理念治疗的43例患者, 称为术中未完全伸直组(43例)。记录手术时间、手术出血量、术后下肢肿胀程度和术后并发症发生率, 记录美国纽约特种外科医院(hospital for special surgery, HSS)膝关节评分、日常生活活动量表(activities of daily living scale, ADLs)和疼痛视觉模拟评分(visual analogue scale, VAS), 比较两组的差异。结果: 所有患者随访时间为(35.85 ± 1.99)个月(范围33~39个月)。术中未完全伸直组患者手术时间更短($P=0.001$), 手术出血量更少($P<0.001$), 术后下肢肿胀程度更轻($P<0.001$)。术中未完全伸直组患者术后3个月较术中完全伸直组的患者存在更大的FD($P=0.038$), 但疼痛程度更轻($P=0.031$), 两组患者术后HSS和ADLs评分未发现显著差异。术后6、12、24、36个月时, 两组患者残留FD、HSS、ADLs和VAS的差异均无统计学意义。两组患者HSS改善程度在术后3~6个月差异有统计学意义($P=0.004$), 其他阶段的差异无统计学意义。术中未完全伸直组患者较术中完全伸直组患者术后深静脉血栓发生率更低($P=0.048$), 而两组患者中远期并发症发生率的差异无统计学意义。结论: 治疗伴有严重FD的膝关节骨关节炎时, TKA术中可以有限地松解组织并适当残留一定程度FD($5^\circ\sim 10^\circ$)不影响膝关节活动度和功能的恢复, 且深静脉血栓发生率更低。

[关键词] 骨关节炎; 关节置换术; 屈曲畸形; 预后

[中图分类号] R684

[文献标志码] A

[文章编号] 1007-4368(2025)04-551-09

doi: 10.7655/NYDXBNSN241460

The effect of residual flexion deformity of certain degree on the efficacy of TKA

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[Abstract] **Objective:** To investigate the effect of residual flexion deformity (FD) to a certain degree during total knee arthroplasty (TKA) on the efficacy in patients with severe FD associated with knee osteoarthritis. **Methods:** A retrospective analysis was conducted at the First Affiliated Hospital of Nanjing Medical University on the 52 patients with severe FD ($>30^\circ$) treated based on the concept of completely correcting FD (within 5°) from October 2013 to September 2017, referred to as the intraoperatively completely-extended group ($n=52$), and the 43 patients treated based on the concept of appropriately retaining a certain degree of FD ($5^\circ\sim 10^\circ$) from October 2017 to September 2021, referred to as the intraoperatively incompletely-extended group ($n=43$). The operation time, intraoperative blood loss, postoperative lower limb swelling, and the incidence of postoperative complications were recorded. The hospital for special surgery (HSS) score, activities of daily living scale (ADLs), and visual analogue scale (VAS) were also to compare the differences between the two groups. **Results:** All patients successfully completed the surgery, and were followed up for (35.85 ± 1.99) months (range 33~39 months). Patients in the intraoperatively incompletely-extended group had shorter surgical time ($P=0.001$), less operative blood loss ($P<0.001$), and had less postoperative lower limb swelling ($P<0.001$). At 3 months post-surgery, patients in the incompletely-extended group had greater residual FD ($P=0.038$) but less pain ($P=0.031$) than those in the completely-extended group. No significant differences were found in postoperative HSS and ADLs scores between the two groups. At 6, 12, 24, and 36 months post-surgery, there

[基金项目] 江苏省自然科学基金(BK20191492)

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were no statistically significant differences in residual FD, HSS, ADLs, and VAS between the two groups. The improvement in HSS scores also showed difference at 3–6 months post-surgery ($P=0.004$), but not at other time points. The incidence of deep vein thrombosis (DVT) was lower in the completely-extended group ($P=0.048$), but there was no statistical difference in the incidence of medium-term and long-term complications between the two groups. **Conclusion:** In the treatment of knee osteoarthritis with severe FD, retaining soft tissue to a limited extent and appropriately retaining a certain degree of FD (5° – 10°) during TKA does not affect the recovery of knee mobility and function and is associated with a lower incidence of DVT.

[Key words] osteoarthritis; arthroplasty; flexion deformity; prognosis

[J Nanjing Med Univ, 2025, 45(04): 551-559]

全膝关节置换术(total knee arthroplasty, TKA)是治疗终末期膝关节骨关节炎(osteoarthritis, OA)的最有效方法^[1]。终末期膝关节OA最常见的畸形是内翻畸形,同时很多患者会出现膝关节伸直受限的情况,称为屈曲畸形(flexion deformity, FD)。既往由于生活水平和医疗条件的限制,膝关节OA患者常因就医时间晚而导致严重FD($FD>30^{\circ}$),随着生活条件改善和就医意识提高,严重FD患者的数量较以往明显减少。尽管如此,仍有部分患者存在严重FD,而矫正伴有严重FD的膝关节是手术医生在TKA术中面临的一大挑战。

有学者认为,TKA术后残留的FD不随时间而改善,需要在术中完全矫正^[2]。一般认为,FD矫正到 5° 以内即做到了完全伸直膝关节^[3]。对于伴有严重FD的膝关节OA,术中为了矫正FD,需要在常规截骨和软组织松解后,进行额外截骨和扩大软组织松解范围。由于膝关节长期存在FD,有时术中软组织松解极其困难,即使进行额外截骨并尽可能松解软组织,也难以在术中完全矫正FD。此外,额外截骨会抬高关节线,改变膝关节的生物力学,导致屈曲中段不稳定^[4]。也有专家认为,随着康复方式和镇痛药物的进步,TKA术中残留一定程度FD对膝关节活动度和功能的恢复无明显影响,仍可通过术后锻炼恢复膝关节伸直^[5],而减少术中操作有助于降低血管神经损伤的风险。目前针对TKA治疗伴有严重FD的膝关节是否需要完全矫正FD缺乏统一意见。

本研究回顾性分析了2013年10月—2021年9月于南京医科大学第一附属医院行TKA且伴有严重FD的膝关节OA患者,根据术中矫正FD的程度,将患者分为术中完全伸直组与术中未完全伸直组,比较两组患者术后膝关节的伸直情况和功能评分,为TKA术中矫正严重FD提供依据。

1 对象和方法

1.1 对象

随访了2013年10月—2017年9月间采用完全矫正FD($<5^{\circ}$)的理念的52例手术患者和2017年10月—2021年9月间采用可以适当残留一定程度FD(5° – 10°)的理念的43例手术患者,将两组患者的资料进行对比分析。最终共有95例被纳入本研究,并有完整的随访资料。其中,男24例,女71例,年龄58~79岁,平均(68.85 ± 4.83)岁,体重指数(body mass index, BMI) $19.70\sim 39.39\text{ kg/m}^2$,平均(26.01 ± 4.50) kg/m^2 。根据TKA术中矫正FD理念的不同,将上述患者分为术中完全伸直组(52例)和术中未完全伸直组(43例)。

纳入标准:①确诊为原发性膝关节骨关节炎(Kellgren-Lawrence分级为IV级);②接受初次单侧TKA;③年龄55~80岁;④术前膝关节 $FD\geq 30^{\circ}$ 。排除标准:①确诊为类风湿关节或强直性脊柱炎等血清学阳性的炎症性关节炎;②接受单髁置换或人工关节翻修;③术前6个月内或随访期间接受外科手术;④临床资料不齐全。本研究经南京医科大学第一附属医院伦理委员会批准(2024-SR-199),所有患者或家属均签署知情同意书。

1.2 方法

1.2.1 手术方式

两组患者均接受初次单侧TKA,假体类型为后交叉韧带替代型(PS型)人工膝关节假体(美国强生公司、深圳捷迈公司或天津正天公司)。所有手术均由同一组经验丰富的主任医师及其团队完成。患者全身麻醉取平卧位。止血带置于大腿根部,设置压力为280 mmHg。屈膝,采用标准正中切口,取常规髌旁内侧入路。切除前后交叉韧带,并在所有病例中进行软组织平衡。基于术前膝关节三维CT

规划手术方案进行个体化截骨, 选择合适大小的试模, 放置膝关节假体并使用骨水泥固定。术中均未行髌骨置换, 对髌骨进行修整及去神经化处理。术毕于关节腔放置引流管并逐层关闭切口。术后患肢予弹力绷带加压包扎, 松开止血带。

1.2.2 FD的矫正

TKA术中行常规软组织松解, 松解步骤包括骨赘去除、半月板切除、交叉韧带切除。试模时若伸直间隙小于屈曲间隙, 考虑增加截骨量或进一步扩大软组织松解范围如后方关节囊和胫骨平台后方。PS型人工膝关节假体的标准股骨远端截骨量均为9 mm。额外截骨选择股骨远端增加2 mm截骨量, 最多不超过4 mm, 避免单独行额外胫骨截骨, 扩大软组织松解范围直至完全伸直膝关节。若术中松解软组织存在困难, 减少额外软组织松解范围, 适当残留不超过10°的FD。

1.2.3 围术期康复

所有康复锻炼均由同一康复团队完成。围术期康复包括预康复和术后康复。

预康复: 患者术前2 d进行预防性锻炼, 包括股四头肌肌力训练和膝关节主动活动度训练。

术后康复: 术后第2天开始肌力训练、活动度训练和负重训练。肌力训练包括: ①踝泵练习, 缓慢用力、全范围屈伸膝关节(10次/h); ②膝关节伸直时紧绷大腿肌肉(股四头肌等长收缩), 持续10 s/次, 20次/组, 2~5组/d; ③直腿抬高, 脚跟离床面15~20 cm, 持续10 s/次, 20次/组, 2~5组/d。活动度训练包括: ①被动压直; ②足跟滑动(膝关节主动屈伸训练); ③活动髌骨; ④床边挂腿, 15 min/组, 3组/d。训练间隙使用冰袋冷敷。夜间将大垫高枕置于患肢后方或抬高床尾, 减轻下肢肿胀。针对膝关节伸直锻炼存在困难的患者, 将小圆枕置于足跟后, 悬空膝关节, 将1~2 kg的沙袋置于膝关节上方及两侧, 锻炼膝关节伸直。术后第2天在负重下使用助行器下地, 进行步行锻炼。术后持续康复锻炼直至出院, 告知患者后续康复计划。

1.2.4 研究参数

记录术中手术时间、手术出血量和术后下肢肿胀程度。由止血带加压后切皮开始, 由弹力绷带加压包扎后松开止血带结束, 确定手术时间。手术出血量由红细胞比容(hematocrit, HCT)法得出。手术开始前, 根据血气分析记录HCT基础值, 术后复查血常规记录HCT值, 根据公式“失血量=(HCT术前-HCT术后)×体重×7%÷HCT”计算得到手术出血量。

于术前和术后第3天测量术侧髌骨上方15 cm大腿和髌骨下方10 cm小腿的周径, 作为下肢肿胀程度的评估指标。完成术前、术后3、6、12、24和36个月的FD、美国纽约特种外科医院(hospital for special surgery, HSS)膝关节评分、日常生活活动量表(activities of daily living scale, ADLs)和疼痛视觉模拟评分(visual analogue scale, VAS)评估。使用HSS评分(最高分100分)评估置换膝关节的整体功能, 使用ADLs量表(最高分100)和VAS疼痛评分(最高分0)评估术后整体满意度。使用长测角仪(50 cm)测量膝关节欠伸角度, 测角仪长边沿着膝关节外侧股骨和胫骨的长轴对齐。记录术后3 d TKA术后下肢深静脉血栓的发生情况, 记录术后3年内并发症的发生情况。

1.3 统计学方法

采用R4.3.2软件进行数据处理和统计学分析。正态分布的计量资料以均数±标准差($\bar{x} \pm s$)表示, 使用独立样本 t 检验比较组间差异。非正态分布的计量资料以中位数(四分位数)[$M(P_{25}, P_{75})$]表示, 使用Mann-Whitney U 检验比较组间差异。采用卡方检验比较分类变量的组间差异。 $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 两组患者术前资料的比较

根据术中矫正严重FD的程度, 将患者分为术中完全伸直组(52例)和术中未完全伸直组(43例), 随访时间(35.85±1.99)个月(33~39个月)。术中完全伸直组女40例, 占76.92%, 术中未完全伸直组女31例, 占72.10%, 两组患者的性别比差异无统计学意义($\chi^2=0.091, P=0.763$)。两组患者年龄($P=0.133$)和BMI($P=0.105$)的差异也无统计学意义。两组在术前FD($P=0.317$)、术前髌上15 cm周径($P=0.148$)、术前髌下10 cm周径($P=0.087$)、HSS($P=0.424$)、ADLs($P=0.122$)和VAS($P=0.097$)的差异均无统计学意义(表1)。

2.2 两组患者手术时间、手术出血量及下肢肿胀程度的比较

比较两组患者的手术时间、手术出血量和下肢肿胀程度, 结果显示术中未完全伸直组与术中完全伸直组比较, 患者的手术时间更短($P=0.001$), 手术出血量更少($P < 0.001$), 术后下肢肿胀程度更轻(两组术后髌上15 cm周径比较 $P < 0.001$, 两组术后髌下10 cm周径比较 $P < 0.001$), 两组间差异有统计学意义(表2)。

表1 两组患者术前资料的比较

Table 1 Comparison of preoperative information between the two groups of patients ($\bar{x} \pm s$)

Variable	Intraoperatively completely-extended group(n=52)	Intraoperatively incompletely-extended group(n=43)	t	P
Age(years)	69.54 ± 4.47	68.01 ± 5.20	1.518	0.133
BMI(kg/m ²)	25.28 ± 2.81	26.89 ± 5.89	-1.649	0.105
Preoperative flexion deformity(°)	32.08 ± 2.11	32.72 ± 3.72	-1.008	0.317
Preoperative circumference 15 cm above the patella(cm)	52.35 ± 4.94	52.83 ± 4.34	1.462	0.148
Preoperative circumference 10 cm below the patella(cm)	39.59 ± 3.58	38.16 ± 3.78	1.732	0.087
Preoperative HSS	47.46 ± 6.07	46.16 ± 9.05	0.803	0.424
Preoperative ADLs	76.92 ± 7.01	74.88 ± 5.72	1.561	0.122
Preoperative VAS	2.85 ± 1.04	3.21 ± 1.06	-1.680	0.097

BMI: body mass index; HSS: hospital for special surgery; ADLs: activities of daily living; VAS: visual analogue scale.

表2 两组患者手术时间、手术出血量及术后下肢肿胀程度的比较

Table 2 Comparison of surgical time, operative blood loss, and postoperative lower limb swelling between the two groups of patients ($\bar{x} \pm s$)

Variable	Intraoperatively completely-extended group(n=52)	Intraoperatively incompletely-extended group(n=43)	t	P
Operation time(min)	91.54 ± 10.73	84.53 ± 9.63	3.349	0.001
Operative blood loss(mL)	819.85 ± 150.63	675.04 ± 208.09	3.812	<0.001
Postoperative circumference 15 cm above the patella(cm)	54.83 ± 4.91	51.51 ± 4.29	3.515	<0.001
Postoperative circumference 10 cm below the patella(cm)	43.98 ± 1.22	41.95 ± 1.21	8.126	<0.001

2.3 两组患者术后残留FD的比较

术中完全伸直组患者术中残留的FD为2.12°±1.56°，术中未完全伸直组患者术中残留的FD为7.15°±0.78°。术中未完全伸直组的患者在术后3个月时残留更大的FD(P=0.038)。在术后6个月(P=0.255)、12个月(P=0.088)、24个月(P=0.074)和36个月(P=0.154)，两组患者残留FD比较，差异均无统计学意义(表3)。

2.4 两组患者术后膝关节功能HSS、ADLs和VAS评分的比较

术后3个月，术中未完全伸直组患者的VAS疼痛程度更轻(P=0.031)，但HSS(P=0.754)和ADLs

(P=0.505)在两组间差异无统计学意义。术后6个月，两组间HSS(P=0.288)、ADLs(P=0.199)和VAS(P=0.249)的差异均无统计学意义。术后12、24、36个月，两组间HSS、ADLs和VAS的差异也均无统计学意义(表4)。

2.5 两组患者术后HSS改善程度的比较

两组患者的HSS改善程度在术后3~6个月的差异有统计学意义(P=0.004)，在6~12个月、12~24个月和24~36个月的差异均无统计学意义(表5)。

2.6 并发症发生率

选择下肢深静脉血栓和切口愈合不良作为术后早期并发症，选择持续疼痛、假体感染、关节异响

表3 两组患者术后残留FD的比较

Table 3 Comparison of postoperative residual FD between two groups of patients [$^{\circ}$, M(P₂₅, P₇₅)]

Time	intraoperatively completely-extended group(n=52)	Intraoperatively incompletely-extended group(n=43)	Z	P
Postoperative month 3	3.00(2.00, 5.00)	5.00(1.00, 8.00)	-2.072	0.038
Postoperative month 6	3.00(0.00, 3.00)	3.00(1.00, 5.00)	-1.138	0.255
Postoperative month 12	1.00(0.00, 2.00)	2.00(0.00, 3.00)	-1.706	0.088
Postoperative month 24	0.00(0.00, 2.00)	1.00(1.00, 2.00)	-1.786	0.074
Postoperative month 36	0.00(0.00, 2.00)	1.00(0.00, 1.00)	-1.426	0.154

表4 两组患者术后HSS、ADLs和VAS评分的比较

Table 4 Comparison of postoperative HSS, ADLs and VAS scores between the two groups of patients ($\bar{x} \pm s$)

Time	Intraoperatively completely-extended group(n=52)	Intraoperatively incompletely-extended group(n=43)	t/Z	P
Postoperative month 3				
HSS[M(P_{25} , P_{75})]	76.00(71.00, 81.00)	73.00(70.00, 84.50)	-0.313	0.754
ADLs($\bar{x} \pm s$)	89.23 \pm 3.88	89.67 \pm 2.52	-0.670	0.505
VAS[M(P_{25} , P_{75})]	2.00(1.00, 2.00)	1.00(0.00, 2.00)	-2.161	0.031
Postoperative month 6				
HSS[M(P_{25} , P_{75})]	81.00(74.00, 83.00)	79.00(77.00, 86.50)	-1.063	0.288
ADLs($\bar{x} \pm s$)	92.69 \pm 4.25	93.60 \pm 2.52	-1.296	0.199
VAS[M(P_{25} , P_{75})]	1.00(0.00, 1.00)	1.00(0.00, 1.00)	-1.152	0.249
Postoperative month 12				
HSS[M(P_{25} , P_{75})]	86.00(83.00, 89.00)	86.00(82.00, 90.00)	-0.011	0.991
ADLs($\bar{x} \pm s$)	94.71 \pm 3.20	94.07 \pm 2.73	1.056	0.294
VAS[M(P_{25} , P_{75})]	1.00(0.00, 1.00)	1.00(0.00, 1.00)	-0.486	0.627
Postoperative month 24				
HSS[M(P_{25} , P_{75})]	86.00(85.00, 89.00)	85.00(82.00, 88.00)	-1.048	0.295
ADLs($\bar{x} \pm s$)	95.00(95.00, 100.00)	95.00(95.00, 100.00)	-0.620	0.535
VAS[M(P_{25} , P_{75})]	0.00(0.00, 1.00)	0.00(0.00, 1.00)	-1.395	0.163
Postoperative month 36				
HSS[M(P_{25} , P_{75})]	90.00(88.00, 91.00)	88.00(86.00, 90.00)	-1.179	0.239
ADLs($\bar{x} \pm s$)	97.50(95.00, 100.00)	95.00(90.00, 100.00)	-1.877	0.060
VAS[M(P_{25} , P_{75})]	0.00(0.00, 0.00)	0.00(0.00, 1.00)	-1.390	0.165

HSS, hospital for special surgery; ADLs, activities of daily living; VAS, visual analogue scale.

表5 两组患者术后HSS改善程度的比较

Table 5 Comparison of postoperative HSS improvement between the two groups of patients [$M(P_{25}, P_{75})$]

Time	Intraoperatively completely-extended group(n=52)	Intraoperatively incompletely-extended group(n=43)	Z	P
Postoperative month 3-6	0.00(0.00, 5.00)	4.00(2.00, 5.00)	-2.918	0.004
Postoperative month 6-12	4.00(2.00, 8.00)	6.00(-0.50, 9.00)	-0.613	0.540
Postoperative month 12-24	1.00(-1.00, 3.00)	0.00(-2.00, 1.00)	-1.587	0.112
Postoperative month 24-36	2.00(2.00, 4.00)	3.00(2.00, 3.50)	-0.638	0.524

HSS, hospital for special surgery.

作为中远期并发症。所有患者均在术前和术后第3天完成双侧下肢血管超声检查, 术后常规抗凝。两组患者术后早期均未发生切口愈合不良。在术中完全伸直组的患者中, 术后新发深静脉血栓19例(36.54%), 其中3例为腘静脉血栓。在术中未完全伸直组的患者中, 术后新发深静脉血栓7例(16.28%), 其中1例为腘静脉血栓。术中未完全伸直组的患者术后深静脉血栓发生率低于术中完全伸直组的患者($\chi^2=3.894, P=0.048$)。术中完全伸直组发生中远期并发症的有5例, 占9.62%, 其中持续疼痛2例, 假体感染1例, 关节异响2例。术中未完

全伸直组的患者, 发生中远期并发症的有4例, 占比9.30%, 其中持续疼痛1例, 假体感染1例, 关节异响2例。两组患者的中远期并发症发生率比较差异无统计学意义($\chi^2=0.001, P=0.999$)。

3 讨论

终末期膝关节OA由于软骨严重磨损和关节结构的退化, 引起关节炎症、韧带松弛、肌肉张力失衡, 继而出现膝关节伸直受限, 产生FD。根据Lombardi的分级标准^[6], 膝关节FD程度可分为轻度($FD < 15^\circ$)、中度($15^\circ \leq FD \leq 30^\circ$)和重度($FD > 30^\circ$)。

FD>30°时常给手术操作带来困难,因此本研究定义FD>30°为严重FD进行分析。

众所周知,伴有严重FD的膝关节的病变特点包括伸直间隙过小、大量骨赘形成、韧带和肌肉挛缩、后方关节囊和腘绳肌挛缩。FD可能导致股四头肌、腘绳肌不能有效地协同收缩,引起肌肉萎缩,伸膝乏力,加剧膝关节的不稳定和疼痛。此外,严重FD可能压迫或牵拉膝周围的神经,如股神经、腓总神经等,引起疼痛、麻木、刺痛感,甚至出现下肢感觉丧失或运动功能障碍。同时,膝关节周围的韧带和关节囊可能会因过度拉伸而功能受损,影响膝关节的稳定性,加重膝关节的磨损和退化。

针对治疗伴有严重FD的膝关节,术中是否需要完全矫正FD目前存在争议。Kim等^[3]指出TKA术中残留0~5°的FD是理想状态。有学者认为术中残留FD的术后改善难以预测,建议在术中完全矫正FD^[7]。若要达成完全矫正FD的目标,TKA术中除了常规截骨和软组织松解,还需要额外截骨和更大范围地松解软组织。软组织松解包括骨赘去除、韧带松解、交叉韧带切除以及后方关节囊松解。Kim等^[4]使用导航系统发现膝关节内侧松解可使FD减少 $5.2^{\circ}\pm 2.8^{\circ}$,后交叉韧带(posterior cruciate ligament, PCL)切除可减少 $2.5^{\circ}\pm 2.2^{\circ}$,去除股骨后方骨赘可减少 $2.7^{\circ}\pm 1.9^{\circ}$ 。此外,可以通过钝性分离与胫骨齐平的腓肠肌肌腱附着点或切开后方关节囊来进一步增加伸直间隙^[8]。

在软组织充分松解的同时,若屈曲间隙尚可,可选择股骨远端额外截骨来增加伸直间隙^[9]。有学者建议,只要FD超过10°就增加2 mm的股骨远端截骨量^[2]。部分学者通过导航精确评估了股骨额外截骨对FD的改善程度。Matziolis等^[9]发现,股骨远端每额外切除1 mm,FD可线性改善 $2.2^{\circ}\pm 0.3^{\circ}$ 。Kim等^[4]观察到股骨远端每额外切除2 mm,FD可矫正 $4.8^{\circ}\pm 0.1^{\circ}$ 。总体而言,股骨远端每额外截骨1 mm,可改善FD约 2° ^[10]。为了避免胫骨平台额外截骨同时增加屈曲间隙和伸直间隙的问题,有学者提出了胫骨近端后中央切片截骨的新技术^[11],用于后方关节囊松解后FD的进一步矫正。

这些矫正FD的手术操作可能造成几个问题:①关节线抬高,低位髌骨发生,髌腱撞击^[12];②软组织损伤加重,并发症发生率增加;③后方关节囊松弛,破坏膝关节稳定性,损伤血管神经。股骨远端额外截骨会抬高关节线,引起TKA术后中段屈曲时的膝关节不稳和低位髌骨^[4,13-14],增加关节翻修的可

能性^[15]。为了避免膝关节不稳和低位髌骨,关节线抬高不应超过4 mm^[16]。腘绳肌对提供膝关节稳定性有一定作用,在TKA术中可能因摆锯振荡、后方关节囊松解或行腘绳肌腱切开术而损伤^[17-19],导致术后疼痛和关节不稳。本研究显示,术中完全伸直组的患者手术时间较术中未完全伸直组更长,手术出血量更多,术后下肢肿胀程度更重,并且术后深静脉血栓发生率更高。针对过多截骨抬高关节线的弊端,机器人辅助的运动学对线TKA(kinematic alignment-TKA, KA-TKA)可以在不抬高关节线的条件下恢复膝关节伸直^[20]。此外,Clark等^[21]通过解剖研究发现,机器人辅助TKA(robotic assisted-TKA, RA-TKA)可以减少医源性软组织损伤。这些研究表明,在TKA术中引入更高精度和个性化的机器人辅助技术,有助于减少与软组织广泛松解和额外截骨相关并发症的发生率^[22-24]。

也有部分学者持相反意见,认为TKA术中软组织松解困难可以残留一定程度FD,通过加强术后锻炼进行矫正。Tanzer等^[25]发现残留的FD会随着康复和物理治疗而改善。另有学者报道TKA术中残留一定程度FD获得的良好结果,包括术后第1年^[26]、第2^[5,27]或3年^[27],甚至第5年和第10年^[28]。因此,部分学者提出,治疗伴有严重FD的膝关节OA,不需要术中完全矫正FD^[29]。本研究显示,术中未完全伸直组的患者,术后3个月较术中完全伸直组的患者残留更大的FD,但疼痛程度更轻,在术后6、12、24、36个月均不影响膝关节FD的矫正和功能恢复。

TKA术后残留FD的因素包括假体设计、手术技术、术前FD和康复^[30-31]。使用PS型假体需要在术中行PCL切除术,该操作即可改善FD^[32]。研究表明,TKA术前预康复和术后早期功能锻炼均有助于加快膝关节功能恢复,降低并发症风险,而出院时的膝关节功能也与远期预后相关^[33-34]。本研究中,术中未完全伸直组的患者,基于专业的康复锻炼,术后6个月即获得了与术中完全伸直组患者类似的疗效,膝关节也能恢复伸直。由于术前长期存在FD,膝关节前方关节囊拉伸,肌腱韧带畸形粘连,术后易因疼痛影响膝关节早期活动度,引起FD复发。专家指出,TKA围术期多模式镇痛有利于改善康复进程和减少深静脉血栓等早期并发症^[35]。本研究在TKA术中予切口局部浸润镇痛,术后予镇痛泵、静脉镇痛和口服消炎镇痛药物,减轻术后疼痛,降低FD复发风险。同时,术中放置引流管^[36]和术后冷冻疗法^[37](冰袋、冷却垫等)也有利于改善膝关

节早期活动度。此外,术后早期使用神经肌肉电刺激疗法也可作为维持股四头肌力量、改善膝关节功能的方式^[38]。

关于TKA术中是否可以残留更多FD这一问题目前研究证明TKA术中残留15°以上的FD对患者预后有不利影响。专家指出TKA术后残留15°或更大的FD会显著降低行走能力和功能^[39],而Quah等^[27]发现术中残留5°~15°的FD在长期康复后可改善至平均0.2°。此外,没有明确证据显示治疗伴有严重FD的膝关节,术中残留5°~10°的FD会影响膝关节术后的活动度和功能。结合既往经验,本研究认为术中残留不超过10°的FD是安全、可恢复的,残留10°以上FD会面临更大的康复风险和更高的并发症发生率^[40]。

本研究探讨了TKA治疗伴有严重FD的膝关节OA时术中残留一定程度FD对疗效的影响,为TKA术中矫正严重FD提供依据。笔者认为,对于伴有严重FD的膝关节OA,在术后充分锻炼的条件下,可以允许在TKA术中进行有限的软组织松解处理,并且适当残留一定程序的FD(5°~10°),而不影响膝关节活动度和功能的恢复,且深静脉血栓发生率更低。此外,研究也存在一些局限性:①样本量小,且为单中心回顾性研究,存在样本的选择性偏倚和观察指标的测量偏倚;②HSS评估膝关节功能存在局限性,WOMAC和SF-36能对TKA术后功能进行更敏感的评估。

利益冲突声明:

所有作者声明无利益冲突。

Conflict of Interests:

All authors declare no conflict of interests.

作者贡献声明:

黄易负责论文选题、研究设计、患者随访、数据收集与分析、论文撰写与修改;杨辉、王锦文、谈正岗、鲍星安和陈有泉负责随访管理、论文修改和审校;范卫民、刘锋负责论文选题、研究设计、手术操作、论文修改和审校。

Author's Contributions:

HUANG Yi was responsible for topic selection, research design, patient follow-up, data analysis, as well as paper writing and revision; YANG Hui, WANG Jinwen, TAN Zhenggang, BAO Xing'an, and CHEN Youquan were in charge of follow-up management and paper revision review; FAN Weimin and LIU Feng contributed to topic selection, research design, surgical procedures, and paper revision review.

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- [收稿日期] 2024-09-30
(本文编辑: 蒋 莉)