

# 全膝关节置换术后膝关节功能加速康复专家共识

华裔骨科学会骨科康复专业委员会

**摘要:**旨在基于加速康复外科(enhanced recovery after surgery, ERAS)理念,制定一套全膝关节置换术(total knee arthroplasty, TKA)后膝关节功能加速康复的专家共识,优化围手术期康复措施,促进患者术后快速恢复膝关节功能。共识制定采用德尔菲法,分为线上问卷调查和线上会议两阶段。首先,通信作者起草17项TKA术后加速康复的临床问题,由专家组进行文献检索和总结。50位专家参与匿名调研,并通过投票反馈意见。通过两次线上会议对草案进行讨论和实时投票,最终确定共识内容。共识依据牛津大学循证医学标准对文献证据及推荐强度进行分级,投票结果按同意率划分为:51%~74%为一致,75%~99%为强一致,100%为完全一致。共识总结了术后膝关节功能恢复的13项条目,包括康复评定、患者教育、术前康复训练、术后疼痛管理、睡眠管理、术后早期活动等。大多数条目获得了88%~100%的投票支持,尤其是术后疼痛管理(100%一致)、术后早期活动(95.45%~100%一致)等关键措施,显示出专家的高度共识。康复评定、患者教育等条目也获得了90%以上的强一致性支持。本文涉及的共识内容聚焦于TKA术后膝关节功能的加速康复,有助于临床医师和治疗师在开展术后康复时有所参考,以制订合适的治疗方案。

**关键词:**膝关节置换术;加速康复;膝关节功能;专家共识

**中图分类号:**R687.4

**文献标志码:**A

## Expert consensus on accelerated recovery of knee function after total knee arthroplasty

Orthopaedic Rehabilitation Special Committee of Chinese Speaking Orthopaedic Society

**Abstract:** This article aims to establish a consensus on accelerated rehabilitation of knee function following total knee arthroplasty (TKA), based on the principles of enhanced recovery after surgery (ERAS). The goal is to optimize perioperative rehabilitation measures and promote rapid recovery of knee function post-surgery. The consensus was developed using the Delphi method, conducted in two phases: an online questionnaire survey and online meetings. Initially, the corresponding authors drafted 17 clinical issues related to accelerated rehabilitation after TKA, which were reviewed and summarized by a panel of experts. A total of 50 experts participated in the anonymous survey, providing feedback through voting. Two online meetings were held to discuss the draft and conduct real-time voting, ultimately finalizing the consensus. The consensus follows the Oxford Centre for Evidence-Based Medicine's standards for evidence grading and recommendation strength. Voting results were categorized as follows: 51%-74% agreement indicated "consensus", 75%-99% indicated "strong consensus", and 100% indicated "complete consensus". The consensus outlines 13 key items for postoperative knee function recovery, including rehabilitation evaluation, patient education, preoperative rehabilitation training, postoperative pain management, sleep management, and early postoperative activities. Most items received high levels of support, with voting approval rates ranging from 88% to 100%. Notably, key measures such as postoperative pain management (100% consensus) and early postoperative activities (95.45%-100% consensus) demonstrated a high degree of agreement among experts. Items related to rehabilitation evaluation and patient education also received strong consensus, with over 90% agreement. The consensus outlined in this article focuses on accelerating knee function recovery following TKA, providing valuable reference for clinicians and therapists in developing appropriate rehabilitation plans.

**Key words:** Total knee arthroplasty; Enhanced recovery; Knee function; Expert consensus

收稿日期:2024-09-14

基金项目:上海市级医院康复医学科专科联盟(SHDC22023304);上海市卫生健康系统重点扶持学科建设项目(2023ZDFC0303);上海康复医学临床医学研究中心(21MC193200)

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膝关节置换术 (total knee arthroplasty, TKA) 是治疗膝关节后期疾病的主要手段之一。2019 年我国全膝关节置换手术量已超过 35 万例,且以每年近 20% 的速率增长<sup>[1]</sup>。随着手术材料和相关技术不断发展以及加速康复外科 (enhanced recovery after surgery, ERAS) 理念的应用,通过其 5 个核心要素:术前准备与宣教、优化麻醉与手术管理、术后疼痛管理、早期活动及营养支持、多学科协作与心理支持等一系列循证医学证据支持的优化措施,减少 TKA 患者的生理和心理创伤,达到快速康复。

基于 ERAS 理念的 TKA 加速康复干预,患者的平均住院时间、首次下床活动时间及首次进食时间缩短,疼痛评分、术后 6 周 HSS 评分、生活质量量表-100 (quality of life, QOL-100) 评分、术后 8 周美国膝关节协会 (American Knee Society, AKS) 评分改善高于传统的康复干预<sup>[2-4]</sup>。目前,国内针对 TKA 术后的围手术期管理<sup>[5]</sup>、康复护理<sup>[6]</sup>、疼痛及睡眠管理<sup>[7]</sup>及围手术期贫血<sup>[8]</sup>等形成了初步的专家共识,推动了国内 TKA 术后加速康复的发展。

但是,TKA 术后功能恢复的程度受个人、社会、临床、手术等因素的影响,如体质量指数 (body mass index, BMI)、个人心理因素、原发疾病的类型及严重程度、是否合并其他合并症、手术方式与时机、假体的选择、康复训练方式及时机等。目前国内尚未针对 TKA 术后加速康复的膝关节功能恢复形成共识。为了达到 TKA 后最小的创伤、最快的康复、最好的疗效,进一步促进患者膝关节功能的恢复,应关注加速康复外科理念在 TKA 患者膝关节功能恢复中的作用。

## 1 资料与方法

共识制定采用了德尔菲法,分为线上问卷调查和线上会议及实时投票两个阶段。首先,两位通信作者起草了 17 项关于 TKA 术后膝关节功能加速康

复的相关临床问题,由专委会中 17 位专家对其进行文献检索、归纳,包括 Pubmed、Web of Science、Embase、Cochrane Library、中国知网、万方数据库、维普资讯、中华医学期刊等数据库,检索时间 2000 年 1 月至 2024 年 8 月,形成初步草案,最终纳入 136 篇文献。第一阶段的线上匿名调研于 2024 年 4 月进行,共 50 位专委会委员参与,专家们可以选择同意、不同意或不确定,并可提出修改意见。所有反馈结果均提交给各条目负责人和两位通信作者,以进一步修订共识草案。

第二阶段的线上会议和实时投票分为两轮。首先,于 2024 年 8 月 18 日召开了第一次线上讨论会,并进行了实时匿名投票,共有 50 位专委会委员参与。各条目负责人按照预定顺序,通过幻灯片陈述结论后,立即进行投票,选项包括“同意”、“修改后同意”、“修改后再次讨论”和“不同意”。第二次线上会议及投票于 2024 年 9 月 1 日举行,针对第一次会议上尚未达成共识的条目,经过各条目负责人修改和重新汇报后,专家再次进行讨论并投票。

专家共识的推荐强度根据投票同意的百分比进行划分:51%~74% 为意见一致,75%~99% 为强一致,100% 为完全赞同<sup>[9]</sup>。同时,每一个条目中所引用的参考文献均根据英国牛津大学循证医学中心制定的证据分级和推荐强度标准进行文献证据等级分级,按照文献等级最高的级别进行推荐,见表 1。

文稿由第一作者执笔,并接受所有作者的修改意见。本共识将 17 个临床问题归纳总结为 13 项具体条目,适用于膝关节骨性关节炎、类风湿关节炎患者接受 TKA 后的膝关节功能加速康复。包括 TKA 康复评定、患者教育、术前康复训练、术后疼痛管理、睡眠管理、体位选择、术后肿胀、术后早期活动、术后康复流程、作业治疗、关节僵硬的早期预防、远程康复和中西医结合康复,以共同促进 TKA 术后膝关节功能的加速康复。

表 1 2009 版牛津大学循证医学中心的证据分级与推荐强度标准  
Table 1 The 2009 Oxford Centre for Evidence-Based Medicine (OCEBM) levels of evidence and grades of recommendation standard

| 推荐强度 | 证据级别 | 治疗或危害                         |
|------|------|-------------------------------|
| A    | 1a   | 同质性随机对照试验的系统综述                |
|      | 1b   | 单个随机对照试验 (可信区间窄)              |
|      | 1c   | “全或无”的病例系列研究                  |
| B    | 2a   | 同质性队列研究的系统综述                  |
|      | 2b   | 单个队列研究 (包括低质量随机对照试验,如随访率<80%) |
|      | 2c   | “结局”研究或生态学研究                  |
|      | 3a   | 同质性病例对照研究的系统综述                |
|      | 3b   | 单独的病例对照研究                     |
| C    | 4    | 病例系列研究 (包括低质量队列或病例对照研究)       |
| D    | 5    | 基于经验未经严格论证的专家意见或评论或基础实验       |

## 2 结 果

### 2.1 条目一:TKA 康复评定

#### 2.1.1 TKA 术前评定

TKA 患者术前需进行一般评定和专科评定:一般评定包括一般体格检查和影像学评估<sup>[10-11]</sup>(证据等级:1b;推荐强度:A;投票同意率:97.83%);专科评定包括疼痛、肌力、关节活动度与稳定性、平衡、本体感觉、步态、活动与参与评定等<sup>[12-19]</sup>(证据等级:

1b;推荐强度:A;投票同意率:95.65%)。

#### 2.1.2 TKA 术后评定

推荐 TKA 患者术后进行康复评定,包括疼痛<sup>[20]</sup>(证据等级:1b;推荐强度:A;投票同意率:93.33%)、肿胀<sup>[21-23]</sup>(证据等级:2b;推荐强度:B;投票同意率:93.33%)、关节活动度<sup>[24-25]</sup>(证据等级:1a;推荐强度:A;投票同意率:88.89%)、睡眠<sup>[26-28]</sup>(证据等级:2b;推荐强度:B;投票同意率:95.56%),见表2。

表2 TKA 康复评定工具  
Table 2 TKA rehabilitation evaluation tools

| 评定项目    | 推荐工具                                                                                                                                         | 证据级别 | 推荐强度 |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------|------|------|
| 疼痛      | 视觉模拟评分法(visual analogue scale, VAS);数字疼痛评分法(numerical pain rating scale, NPRS)                                                               | 1b   | A    |
| 肌力      | 徒手肌力评定(manual muscle test, MMT)                                                                                                              |      |      |
| 关节活动度   | 关节测量尺和关节活动度测量仪;X线、CT或MRI等影像学测量法                                                                                                              | 1a   | A    |
| 肿胀      | 卷尺测量腿围法;生物电阻抗技术                                                                                                                              | 2b   | B    |
| 平衡      | Berg平衡量表(berg balance scale, BBS)                                                                                                            |      |      |
| 睡眠      | 艾普沃思嗜睡量表(epworth sleepiness scale, ESS);匹兹堡睡眠质量指数量表(pittsburgh sleep quality index, PSQI)                                                    | 2b   | B    |
| 步行      | 起立-行走计时试验(The timed up and go, TUG);6 min 步行测试(6-minute walk test, 6MWT);交替台阶试验;由坐到站测试;单腿站立试验                                                | 1b   | A    |
| 膝关节功能量表 | HSS 膝关节功能评分(the hospital for special surgery knee score, HSS);骨关节炎指数(western ontario and mc-Master universities osteoarthritis index, WOMAC) | 1b   | A    |

### 2.2 条目二:患者教育

#### 2.2.1 营养摄入

营养不良会增加 TKA 术后并发症风险,包括持续的伤口引流、伤口愈合延迟、手术部位感染和重症监护病房入院等<sup>[29]</sup>。TKA 患者在术前等待期内进行高蛋白饮食,可通过摄入瘦肉、鱼类、蛋类、豆制品和奶制品等食品来增加蛋白质的摄入<sup>[30]</sup>(证据等级:2b;推荐强度:B;投票同意率:88.89%)。建议对膝关节置换术患者术后饮食采用分期调配的模式<sup>[31]</sup>,逐渐由流质或半流质饮食过渡到正常饮食(证据等级:2b;推荐强度:B;投票同意率:88.89%)。

#### 2.2.2 血糖管理

血糖教育不仅限于糖尿病患者。无论患者是否为糖尿病患者,术前和术中可能出现的低血糖或高血糖情况都需要密切关注<sup>[32-33]</sup>。对每例患者,都要提醒其对血糖以及饮食的关注和控制,调配自身饮食习惯,随时监测血糖水平;术后即刻进行血糖监测,采取适当的措施确保患者的血糖水平保持在安全范围内

(证据等级:2b;推荐强度:B;投票同意率:95.56%)。

#### 2.2.3 康复治疗

TKA 术后早期锻炼是重要的健康教育内容,应在门诊时就对患者加以宣教。术后即刻的康复锻炼可以增加患者力量<sup>[34]</sup>,改善疼痛<sup>[35]</sup>,调节情绪<sup>[36]</sup>,并且没有相关证据证明即刻康复会导致伤害的出现(证据等级:2b;推荐强度:B;投票同意率:91.11%)。

### 2.3 条目三:术前康复训练

#### 2.3.1 肌力训练

推荐计划施行 TKA 的患者进行术前肌力训练,可以减少术后并发症的风险,增加肌肉力量,缩短住院时间<sup>[37]</sup>。肌力训练的方法包括强化训练、下肢肌肉力量训练、柔韧性训练<sup>[38-40]</sup>、渐进抗阻训练<sup>[41-42]</sup>和低强度慢动作训练<sup>[43]</sup>(证据等级:1a;推荐强度:A;投票同意率:92.86%)。

#### 2.3.2 平衡训练

计划施行 TKA 的患者术前进行平衡训练,可结

合平衡训练、本体感觉训练<sup>[42,44-45]</sup>(证据等级:1a;推荐强度:A;投票同意率:90.48%)。

### 2.3.3 呼吸及咳嗽训练

计划施行 TKA 的患者术前进行呼吸及咳嗽训练,有助于患者术后进行有效且正确的呼吸,减轻患者术后的疼痛和焦虑<sup>[46]</sup>,推荐腹式呼吸训练、深呼吸训练和有效咳嗽训练<sup>[47]</sup>(证据等级:2a,推荐强度:B。投票同意率:92.86%)。

### 2.3.4 日常生活能力训练及辅具使用

推荐计划施行 TKA 的患者术前进行日常生活能力训练(如体位转移训练)及辅具指导训练(如学习使用拐杖、助行器等)<sup>[48]</sup>,有助于术后更快地恢复自理能力<sup>[49-50]</sup>(证据等级:2a;推荐强度:B;投票同意率:92.86%)。

## 2.4 条目四:术后疼痛管理

### 2.4.1 多模式镇痛策略

TKA 术后实施多模式镇痛策略,结合不同作用机制的镇痛药物和方法,以优化镇痛效果并减少不良反应<sup>[51-53]</sup>(证据等级:1b;推荐强度:A;投票同意率:100%)。

### 2.4.2 股神经阻滞技术

TKA 术后可采用股神经阻滞技术,以有效管理术后疼痛<sup>[54-56]</sup>(证据等级:1b;推荐强度:A;投票同意率:79.55%)。

股神经阻滞术适用于<sup>[54-56]</sup>:①股前和小腿内侧皮肤的知觉障碍或异常;②耻肌、股四头肌、缝匠肌及内收肌群部位的疼痛痉挛、萎缩、麻痹等征象;③膝关节中重度疼痛性疾患;④如同时阻滞坐骨神经可用于膝关节、小腿手术的麻醉和术后镇痛。

### 2.4.3 预防性镇痛策略

TKA 术后可采取预防性镇痛策略,即在疼痛出现前给予镇痛药物或康复干预措施,以提高患者的痛阈,减少术后疼痛的发生和程度<sup>[57-58]</sup>(证据等级:1b;推荐强度:A;投票同意率:93.18%)。

## 2.5 条目五:睡眠管理

### 2.5.1 睡眠管理

认知行为疗法可改善 TKA 术后患者睡眠(证据等级:1b;推荐强度:A;投票同意率:100%)。推荐对 TKA 术后单纯性失眠患者使用镇静催眠药物,如苯二氮卓类药物<sup>[59-60]</sup>(氯硝西泮/地西泮/阿普唑仑/艾司唑仑片)或非苯二氮卓类药物(思诺思或扎来普隆)<sup>[7]</sup>(证据等级:1b;推荐强度:A;投票同意率:97.56%)。

### 2.5.2 失眠伴焦虑患者

建议对失眠伴有明显焦虑情绪的 TKA 术后患者以抗焦虑治疗为主,主要使用选择性 5 羟色胺再摄取抑制剂类药物(SSRIs 类),如帕罗西汀、氟西汀、舍曲林,并辅助使用镇静催眠药物<sup>[7,61-62]</sup>(证据等级:1b;推荐强度:A;投票同意率:97.56%)。

### 2.5.3 疼痛导致的睡眠障碍

建议对疼痛导致的 TKA 术后失眠患者予以多模式镇痛方案,如非甾体类抗炎药治疗(如塞来昔布、罗非考昔)、GABA 类似物、神经阻滞等,旨在减少药物不良反应<sup>[63-65]</sup>(证据等级:1a;推荐强度:A;投票同意率:92.68%)。

## 2.6 条目六:体位选择

### 2.6.1 术后体位

建议 TKA 患者术后至少保持 24 h 患侧膝关节屈曲位(30°~60°),以减少术后出血和膝关节肿胀<sup>[49,66]</sup>(证据等级:1a;推荐强度:A;投票同意率:75.56%)。

依据说明:多项 META 以及 RCT 研究显示,TKA 术后患侧膝关节维持至少 24 h 轻度屈曲(30°~60°)体位,较伸直位比较可显著降低总失血量、减少输血需求<sup>[49,66-69]</sup>,促进静脉回流,降低膝关节肿胀程度,术后 1 周膝关节活动度(range of motion, ROM)更佳,且不会增加伤口相关感染、下肢深静脉血栓或肺栓塞的风险<sup>[70-71]</sup>。多项 RCT 研究显示,在 TKA 术后采用患膝屈曲位有助于术后早期膝关节屈曲活动度改善<sup>[69-70,72]</sup>,但在术后 6 周时与采用患膝伸直位相比,膝关节屈曲活动度并无显著差异<sup>[68,73]</sup>。TKA 术后早期屈膝体位对改善膝关节活动范围存在短期效应,但研究结果均未明确是否会对患侧伸膝功能产生影响,且所有研究都在维持屈膝体位结束后,立即开展主被动关节活动等康复治疗。

### 2.6.2 康复体位选择

建议在物理治疗师督导下开展早期康复,同时应避免过度屈膝、深蹲、盘腿及跪位<sup>[49]</sup>(证据等级:2b;推荐强度:B;投票同意率:100%)。

### 2.6.3 患肢抬高

建议术后仰卧位时抬高术侧下肢,以减轻下肢水肿并避免深静脉血栓<sup>[74]</sup>(证据等级:5;推荐强度:D;投票同意率:93.33%)。

## 2.7 条目七:术后肿胀

### 2.7.1 抬高患肢

推荐 TKA 术后早期采用患侧髌关节屈曲

(30°)、膝关节屈曲位(30°~90°),以减轻下肢水肿,且连续屈曲时间不超过6 h(证据等级:1a;推荐强度:A;投票同意率:76.74%)。

依据说明:TKA术后抬高患肢并屈曲膝关节可减少TKA术后失血量,且轻度屈曲位的静脉血流速度明显快于膝关节完全伸展位,也可减少TKA术后膝关节肿胀,促进膝关节功能恢复,缓解疼痛,并预防深静脉血栓发生<sup>[75-76]</sup>。但是关于屈曲及抬高的角度、持续时间仍没有最优推荐,且临床实践中观察到膝关节屈曲时间超过6 h存在潜在风险<sup>[77]</sup>,目前尚不明确屈曲时间增加与膝关节屈曲挛缩的关系,因此我们建议膝关节连续屈曲时间不超过6 h。

在多项研究中发现<sup>[68-69,78]</sup>:不同体位患者术后6周的关节活动度、肿胀、疼痛无显著差异,表明术后早期的体位管理仅可缓解术后肿胀,对患者远期的康复无特殊影响。

### 2.7.2 冷疗

TKA术后24 h内患者进行冷疗,对缓解疼痛、改善活动度、减少积液生成有积极作用(证据等级:1a;推荐强度:A;投票同意率:93.02%)。

冷疗可降低TKA术后关节内温度,减缓神经传导速度,缓解疼痛,并且还能减少外周血流量,引起血管收缩,减少炎症和局部肿胀<sup>[79-81]</sup>,冷疗在TKA术后即可进行,每日冷疗的时间及频次目前无统一标准。

### 2.7.3 人工淋巴引流手法

人工手法淋巴引流可有效改善早期TKA术后的疼痛和大腿肿胀,建议在TKA术后早期进行<sup>[82-84]</sup>(证据等级:2b;推荐强度:B;投票同意率:88.37%)。

### 2.7.4 肌内效贴

TKA术后可采用肌内效贴治疗水肿,可加速皮下组织引流并减少皮下肿胀<sup>[85-89]</sup>(证据等级:1a;推荐强度:A;投票同意率:86.05%)。

## 2.8 条目八:术后早期活动(24 h内)

### 2.8.1 持续被动活动(continuous passive motion, CPM)

初次、非复杂性TKA不应该使用CPM,CPM对膝关节功能的改善没有帮助,不能减少住院时长<sup>[48,90-91]</sup>(证据等级:1a;推荐强度:A;投票同意率:95.45%)。

### 2.8.2 冷疗

TKA患者术后应早期使用冷疗,治疗师应教会患者自己使用,加压冷疗对术后膝关节疼痛和功能

有积极影响<sup>[49,92]</sup>(证据等级:1b;推荐强度:A;投票同意率:95.45%)。

### 2.8.3 主动活动

TKA术后应该抬高术侧肢体(证据等级:2b;推荐强度:B;投票同意率:95.45%),尽早开始踝泵运动<sup>[93-94]</sup>(证据等级:1b;推荐强度:A;投票同意率:100%),股四头肌、腘绳肌等长训练<sup>[48,95-96]</sup>(证据等级:1a;推荐强度:A;投票同意率:100%),建议术后第1天应尽量下床活动<sup>[97-98]</sup>(证据等级:2a;推荐强度:B;投票同意率:95.45%),可提高患者活动能力,减轻疼痛,缩短住院时间。

### 2.8.4 经皮神经电刺激(Transcutaneous Electrical Nerve Stimulation, TENS)

TKA术后早期使用TENS可以减轻疼痛<sup>[48,99-100]</sup>,减少麻醉药的用量,同时提高下肢功能<sup>[101-102]</sup>(证据等级:1a;推荐强度:A;投票同意率:95.45%)。

## 2.9 条目九:术后康复流程(24 h~1周)

### 2.9.1 康复训练

TKA术后24~48 h内,患者在医护人员指导下开始轻度活动,如踝泵运动<sup>[103-104]</sup>,ROM训练,包括被动、主动和主动辅助关节活动度练习<sup>[105]</sup>,以促进血液循环、减少肿胀,并逐步过渡到更复杂的康复动作(证据等级:1a;推荐强度:A;投票同意率:90.48%)。术后早期开始步态训练(证据等级:2a;推荐强度:B;投票同意率:92.86%)、肌力训练(股四头肌、腘绳肌)和综合康复训练<sup>[103,106]</sup>(证据等级:1b;推荐强度:A;投票同意率:92.86%)。

### 2.9.2 物理因子治疗

TKA术后可采用神经肌肉电刺激<sup>[107-108]</sup>(证据等级:1a;推荐强度:A;投票同意率:88.1%)、低能量激光疗法<sup>[109]</sup>(证据等级:2a;推荐强度:B;投票同意率:88.1%)、体外冲击波疗法<sup>[110]</sup>(证据等级:2a;推荐强度:B;投票同意率:88.1%)可改善疼痛,促进TKA术后早期膝关节功能恢复。

### 2.9.3 运动想象疗法

TKA术后采用运动想象疗法,可增强肌力、减轻疼痛和改善摆动阶段的膝关节最大屈曲角度<sup>[111-112]</sup>(证据等级:1a;推荐强度:A;投票同意率:88.1%)。

## 2.10 条目十:作业治疗

### 2.10.1 日常生活活动能力训练

建议在出院前为初次接受TKA的患者提供日

常生活活动建议和居家康复锻炼计划;认知障碍、难以管理日常生活活动或持续功能障碍导致特定康复需求的患者在专业人员监督下进行康复锻炼;建议居家锻炼初期在家属陪同下开展<sup>[113-114]</sup>(证据等级:1b;推荐强度:A;投票同意率:90.91%)。

TKA 围手术期需要根据患者的病情进展及功能情况,进行早期 ADL 指导及中后期 ADL 宣教:①在术后当日即介入作业治疗,指导患者进行踝泵训练,各项体位下做好良肢位摆放,如床上长坐位下靠座进食,健侧卧位下睡眠等。②术后 1 d,指导患者体位转移,如卧坐转移至床边独坐,借助助行器进行坐立转移,并指导步行转移,进行室内短距离步行,卫生间自我修饰等。③术后 2 d,指导患者独立完成自主穿衣的活动,过程中需注意伤口有无渗出。④术后 3 d 至出院,继续维持上述治疗,出院前指导患者居家活动的注意事项,提出环境调整的建议,预防跌倒发生。

## 2.10.2 认知行为干预

心理因素,如疼痛灾难性思维、恐动症、焦虑和抑郁,与 TKA 后的不良结果相关<sup>[115-116]</sup>,推荐对 TKA 患者进行术前、术后疼痛宣教和认知行为干预,指导患者和家属正确的术后疼痛管理(证据等级:1a;推荐强度:A;投票同意率:95.12%)。

## 2.10.3 环境改造

推荐对 TKA 术后患者进行环境调适的指导,如卫生间改造、床椅调整、房间布局改造、辅具使用等<sup>[117-118]</sup>(证据等级:5;推荐强度:D;投票同意率:90.24%)。

## 2.11 条目十一:关节僵硬的早期预防

### 2.11.1 持续被动运动

不推荐对 TKA 术后患者早期常规使用 CPM 预防关节僵硬<sup>[91,119]</sup>(证据等级:1a;推荐强度:A;投票同意率:86.05%)。

### 2.11.2 早期康复

推荐 TKA 术后早期康复介入可以预防关节僵硬<sup>[93,120-121]</sup>(证据等级:1a;推荐强度:A;投票同意率:97.67%)。

### 2.11.3 非甾体抗炎药

推荐 TKA 术后合理使用非甾体抗炎药以预防关节僵硬<sup>[120,122]</sup>(证据等级:2b;推荐强度:B;投票同意率:88.37%)。

## 2.12 条目十二:远程康复

TKA 术后患者可在专业康复人员指导下进行

远程康复训练,在恢复功能活动能力、降低跌倒风险和疼痛综合征的严重程度以及提高对体育锻炼的依从性方面是安全有效的<sup>[123-125]</sup>(证据等级:2a;推荐强度:B;投票同意率:88.1%)。

## 2.13 条目十三:中西医结合康复

### 2.13.1 中西医结合术后镇痛

推荐在 TKA 围手术期采取针刺治疗<sup>[126-127]</sup>、中医耳穴贴压<sup>[128-129]</sup>、推拿联合常规镇痛方式缓解 TKA 术后疼痛<sup>[130-131]</sup>(证据等级:1a;推荐强度:A;投票同意率:86.05%)。

### 2.13.2 中西医结合改善 ROM

对于术后存在 ROM 受限的患者,推荐联合针刺<sup>[126-127]</sup>、耳穴贴压方式<sup>[128-129]</sup>增加膝关节的活动范围(证据等级:1a;推荐强度:A;投票同意率:76.74%);推荐使用针刺结合常规治疗、推拿手法联合本体感觉和平衡训练促进术后膝关节功能恢复<sup>[132-133]</sup>(证据等级:1a;推荐强度:A;投票同意率:81.40%)。

### 2.13.3 中西医结合改善肿胀、胃肠功能障碍

推荐术后早期在常规护理方法的基础上配合针灸疗法改善 TKA 术后肿胀<sup>[134-135]</sup>(证据等级:2b;推荐强度:B;投票同意率:83.72%);推荐 TKA 术后联合针灸、耳穴埋针或贴压缓解恶心呕吐、腹胀便秘、尿潴留等术后并发症<sup>[136]</sup>(证据等级:1a;推荐强度:A;投票同意率:93.02%)。

## 3 总结与展望

TKA 术后加速康复的实施涉及多个环节,如术前评定、患者教育、疼痛管理、早期活动及康复训练、关节僵硬的早期预防等,都对患者膝关节功能恢复有显著影响。在制定本共识时,采用德尔菲法确保了各项建议的科学性和可行性。对于每个临床问题的文献检索和专家反馈,也显示了对循证医学的重视。我们期待通过进一步的研究和临床实践,深化对 ERAS 理念在 TKA 术后功能恢复中的应用,以期实现更优化的康复效果。未来应加强对个体化康复方案的探索,特别是针对不同患者群体的特定需求,从而提升术后功能恢复的整体水平。同时,持续完善术前、术中和术后的多学科协作模式,促进患者在生理和心理上的全面康复,最终实现膝关节功能的最大化恢复与生活质量的提升。

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## 参考文献:

- [1] Wei ZQ, Xu YM, Feng B, et al. The impact of COVID-19 on hip and knee arthroplasty surgical volume in China [J]. *Int Orthop*, 2024, 48(1): 49-56.
- [2] 张驰, 庞素芳, 王彤, 等. 基于康复评定的加速康复外科干预对髌膝关节置换功能恢复的影响[J]. *中国康复医学杂志*, 2022, 37(7): 967-970.
- [3] 柴瑞宝, 刘茄, 陈睿. 全膝关节置换加速康复的早期结果[J]. *中国矫形外科杂志*, 2021, 29(10): 895-900.  
CHAI Ruibao, LIU Jia, CHEN Rui. Short-term outcome of enhanced recovery after surgery of total knee arthroplasty [J]. *Orthopedic Journal of China*, 2021, 29(10): 895-900.
- [4] 韩广毅, 李皓桓. 快速康复外科理念对全膝关节置换者生理与心理康复的影响[J]. *中国组织工程研究*, 2019, 23(36): 5760-5765.  
HAN Guangtao, LI Haohuan. Influence of the concept of fast track surgery on the physiological and psychological rehabilitation of patients undergoing total knee arthroplasty [J]. *Chinese Journal of Tissue Engineering Research*, 2019, 23(36): 5760-5765.
- [5] 中国老年保健协会. 髌膝关节置换围手术期加速康复专家共识[J]. *实用骨科杂志*, 2021, 27(11): 961-965.
- [6] 杨琳, 杨志英. ERAS 协会“髌/膝关节置换术围术期加速康复护理共识”解读[J]. *护理研究*, 2021, 35(11): 1881-1885.
- YANG Lin, YANG Zhiying. Interpretation of “consensus statement for perioperative care in total hip replacement and total knee replacement surgery: enhanced Recovery After Surgery Society recommendations” [J]. *Chinese Nursing Research*, 2021, 35(11): 1881-1885.
- [7] 沈彬, 翁习生, 廖刃, 等. 中国髌、膝关节置换术加速康复: 围术期疼痛与睡眠管理专家共识[J]. *中华骨与关节外科杂志*, 2016, 9(2): 91-97.  
SHEN Bin, WENG Xisheng, LIAO Ren, et al. Expert consensus in enhanced recovery after total hip and knee arthroplasty in China: pain and sleep management [J]. *Chinese Journal of Bone and Joint Surgery*, 2016, 9(2): 91-97.
- [8] 周宗科, 翁习生, 向兵, 等. 中国髌、膝关节置换术加速康复: 围术期贫血诊治专家共识[J]. *中华骨与关节外科杂志*, 2016, 9(1): 10-15.  
ZHOU Zongke, WENG Xisheng, XIANG Bing, et al. Expert consensus in enhanced recovery after total hip and knee arthroplasty in China: diagnosis and treatment of perioperative anemia [J]. *Chinese Journal of Bone and Joint Surgery*, 2016, 9(1): 10-15.
- [9] Dombrowski ME, Yasui Y, Murawski CD, et al. International Consensus Group on Cartilage Repair of the Ankle. Conservative Management and Biological Treatment Strategies: Proceedings of the International Consensus Meeting on Cartilage Repair of the Ankle [J]. *Foot Ankle Int*, 2018, 39(1\_suppl): 9S-15S.
- [10] Lan S, Li J. Assessment of preoperative planning and intraoperative accuracy of the AIKNEE system for total

- knee arthroplasty [J]. *BMC Musculoskelet Disord*, 2024, 25(1): 562.
- [11] O'Connor MI, Kransdorf MJ. Customized knee arthroplasty and the role of preoperative imaging[J]. *AJR Am J Roentgenol*, 2013, 201(3): 443-450.
- [12] Calatayud J, Casaña J, Ezzatvar Y, et al. High-intensity preoperative training improves physical and functional recovery in the early post-operative periods after total knee arthroplasty: a randomized controlled trial [J]. *Knee Surg Sports Traumatol Arthrosc*, 2017, 25(9): 2864-2872.
- [13] Gstöettner M, Raschner C, Dirnberger E, et al. Preoperative proprioceptive training in patients with total knee arthroplasty[J]. *Knee*, 2011, 18(4): 265-270.
- [14] Casaña J, Calatayud J, Ezzatvar Y, et al. Preoperative high-intensity strength training improves postural control after TKA: randomized-controlled trial [J]. *Knee Surg Phys Traumatol Arthrosc*, 2019, 27(4): 1057-1066.
- [15] Do K, Yim J. Effects of muscle strengthening around the hip on pain, physical function, and gait in elderly patients with total knee arthroplasty: a randomized controlled trial[J]. *Healthcare (Basel)*, 2020, 8(4): 489.
- [16] An J, Son YW, Lee BH. Effect of combined kinematic chain exercise on physical function, balance ability, and gait in patients with total knee arthroplasty: a single-blind randomized controlled trial [J]. *Int J Environ Res Public Health*, 2023, 20(4): 3524.
- [17] Pournajaf S, Goffredo M, Pellicciari L, et al. Effect of balance training using virtual reality-based serious games in individuals with total knee replacement: a randomized controlled trial [J]. *Ann Phys Rehabil Med*, 2022, 65(6): 101609.
- [18] Gränicher P, Mulder L, Lenssen T, et al. Exercise- and education-based prehabilitation before total knee arthroplasty: a pilot study [J]. *J Rehabil Med*, 2024, 56: jrm18326.
- [19] Nguyen C, Boutron I, Roren A, et al. Effect of prehabilitation before total knee replacement for knee osteoarthritis on functional outcomes: a randomized clinical trial [J]. *JAMA Netw Open*, 2022, 5(3): e221462.
- [20] Edwards RR, Campbell C, Schreiber KL, et al. Multimodal prediction of pain and functional outcomes 6 months following total knee replacement: a prospective cohort study [J]. *BMC Musculoskelet Disord*, 2022, 23(1): 302.
- [21] Yau LK, Henry FU, Man Hong C, et al. Swelling assessment after total knee arthroplasty [J]. *J Orthop Surg (Hong Kong)*, 2022, 30(3): 10225536221127668.
- [22] Heo SM, Harris I, Naylor J, et al. Complications to 6 months following total hip or knee arthroplasty: observations from an Australian clinical outcomes registry [J]. *BMC Musculoskelet Disord*, 2020, 21(1): 602.
- [23] Carmichael J, Dennis D, Jennings J, et al. Feasibility and initial efficacy of a multimodal swelling intervention after total knee arthroplasty: a prospective pilot study with historical controls [J]. *Knee*, 2022, 35: 25-33. doi:10.1016/j.knee.2022.01.008.
- [24] Pinsornsak P, Kanitnate S, Boontanapibul K. The effect of immediate post-operative knee range of motion photographs on post-operative range of motion after total knee arthroplasty [J]. *Int Orthop*, 2021, 45(1): 101-107.
- [25] Ha CW, Park YB, Song YS, et al. Increased range of motion is important for functional outcome and satisfaction after total knee arthroplasty in asian patients [J]. *J Arthroplasty*, 2016, 31(6): 1199-1203.
- [26] Naqvi SY, Rabiei AH, Maltenfort MG, et al. Perioperative complications in patients with sleep apnea undergoing total Joint arthroplasty [J]. *J Arthroplasty*, 2017, 32(9): 2680-2683.
- [27] Manning BT, Kearns SM, Bohl DD, et al. Prospective assessment of sleep quality before and after primary total joint replacement [J]. *Orthopedics*, 2017, 40(4): e636-e640.
- [28] Gibian JT, Bartosiak KA, Lucey BP, et al. Sleep disturbances following total knee arthroplasty [J]. *J Arthroplasty*, 2023, 38(6S): S120-S124.
- [29] Jaber FM, Parvizi J, Haytmanek CT, et al. Procrastination of wound drainage and malnutrition affect the outcome of joint arthroplasty [J]. *Clin Orthop Relat Res*, 2008, 466(6): 1368-1371.
- [30] Xu H, Liu L, Xie J, et al. A pre-operative high-protein diet can improve the serum albumin levels of patients undergoing total knee arthroplasty [J]. *Chin Med J (Engl)*, 2023, 136(4): 491-493.
- [31] 李春花. 分期护理配合运动指导在全膝关节置换患者术后功能康复中的临床研究 [J]. *国际护理学杂志*, 2014, 33(12): 3285-3288.
- LI Chunhua. Clinical research of staging nursing combined and motion guidance in postoperative function rehabilitation of patients with total knee replacement [J]. *International Journal of Nursing*, 2014, 33(12): 3285-3288.
- [32] Marchant MH, Viens NA, Cook C, et al. The impact of glycemic control and diabetes mellitus on perioperative outcomes after total joint arthroplasty [J]. *J Bone Joint Surg Am*, 2009, 91(7): 1621-1629.
- [33] Mraovic B, Suh D, Jacovides C, et al. Perioperative hyperglycemia and postoperative infection after lower limb arthroplasty [J]. *J Diabetes Sci Technol*, 2011, 5(2): 412-418.
- [34] Konnyu KJ, Thoma LM, Cao WN, et al. Rehabilitation for total knee arthroplasty: a systematic review [J]. *Am*

- J Phys Med Rehabil, 2023, 102(1): 19-33.
- [35] Eymir M, Unver B, Karatosun V. Relaxation exercise therapy improves pain, muscle strength, and kinesiophobia following total knee arthroplasty in the short term: a randomized controlled trial[J]. Knee Surg Phys Traumatol Arthrosc, 2022, 30(8): 2776-2785.
- [36] Raad G, Tanios J, Azoury J, et al. Neurophysiology of cognitive behavioural therapy, deep breathing and progressive muscle relaxation used in conjunction with ART treatments: a narrative review[J]. Hum Reprod Update, 2021, 27(2): 324-338.
- [37] Konnyu KJ, Thoma LM, Cao W, et al. Prehabilitation for total knee or total hip arthroplasty: a systematic review[J]. Am J Phys Med Rehabil, 2023, 102(1): 1-10.
- [38] Wu Z, Wang Y, Li C, et al. Preoperative strength training for clinical outcomes before and after total knee arthroplasty: a systematic review and meta-analysis[J]. Front Surg, 2022, 9: 879593.
- [39] Punnoose A, Claydon-Mueller LS, Weiss O, et al. Prehabilitation for patients undergoing orthopedic surgery: a systematic review and meta-analysis[J]. JAMA Netw Open, 2023, 6(4): e238050.
- [40] Wang D, Wu T, Li Y, et al. A systematic review and meta-analysis of the effect of preoperative exercise intervention on rehabilitation after total knee arthroplasty[J]. Ann Palliat Med, 2021, 10(10): 10986-10996.
- [41] Skoffer B, Maribo T, Mechlenburg I, et al. Efficacy of preoperative progressive resistance training on postoperative outcomes in patients undergoing total knee arthroplasty[J]. Arthritis Care Res (Hoboken), 2016, 68(9): 1239-1251.
- [42] Domínguez-Navarro F, Silvestre-Muñoz A, Igual-Camacho C, et al. A randomized controlled trial assessing the effects of preoperative strengthening plus balance training on balance and functional outcome up to 1 year following total knee replacement[J]. Knee Surg Phys Traumatol Arthrosc, 2021, 29(3): 838-848.
- [43] 付晓伟, 邵正海, 许彩霞, 等. 术前低强度慢动作训练对膝骨性关节炎患者全膝关节置换术后早期股四头肌肌力的影响[J]. 医学临床研究, 2021, 38(12): 1822-1825.  
FU Xiaowei, SHAO Zhenghai, XU Caixia, et al. Effect of preoperative low intensity slow motion training on quadriceps femoris muscle strength in patients with knee osteoarthritis after total knee arthroplasty[J]. Journal of Clinical Research, 2021, 38(12): 1822-1825.
- [44] Moutzouri M, Gleeson N, Billis E, et al. What is the effect of sensori-motor training on functional outcome and balance performance of patients' undergoing TKR? A systematic review[J]. Physiotherapy, 2016, 102(2): 136-144.
- [45] Blasco JM, Acosta-Ballester Y, Martínez-Garrido, et al. The effects of preoperative balance training on balance and functional outcome after total knee replacement: a randomized controlled trial[J]. Clin Rehabil, 2020, 34(2): 182-193.
- [46] Lim YC, Yobas P, Chen HC. Efficacy of relaxation intervention on pain, self-efficacy, and stress-related variables in patients following total knee replacement surgery[J]. Pain Manag Nurs, 2014, 15(4): 888-896.
- [47] Drewniok N, Kiselev J, Daum N, et al. Concepts for exercise therapy in prehabilitation for elderly people with frailty or pre-frailty prior to elective surgery. A scoping review[J]. J Bodyw Mov Ther, 2023, 36: 74-82. doi: 10.1016/j.jbmt.2023.05.004.
- [48] 中国老年医学学会康复分会, 全膝关节置换围手术期康复干预中国专家共识组. 全膝关节置换围手术期康复干预中国专家共识[J]. 中华物理医学与康复杂志, 2024, 46(2): 97-104.
- [49] Jette DU, Hunter SJ, Burkett L, et al. Physical therapist management of total knee arthroplasty[J]. Phys Ther, 2020, 100(9): 1603-1631.
- [50] Anderson AM, Comer C, Smith TO, et al. Consensus on pre-operative total knee replacement education and prehabilitation recommendations: a UK-based modified Delphi study[J]. BMC Musculoskelet Disord, 2021, 22(1): 352.
- [51] Pogatzki-Zahn EM, Zahn PK. From preemptive to preventive analgesia[J]. Curr Opin Anaesthesiol, 2006, 19(5): 551-555.
- [52] Clarke H, Poon M, Weinrib A, et al. Preventive analgesia and novel strategies for the prevention of chronic post-surgical pain[J]. Drugs, 2015, 75(4): 339-351.
- [53] Zhao J, Davis SP. An integrative review of multimodal pain management on patient recovery after total hip and knee arthroplasty[J]. Int J Nurs Stud, 2019, 98: 94-106. doi:10.1016/j.ijnurstu.2019.06.010.
- [54] YaDeau JT, Cahill JB, Zawadsky MW, et al. The effects of femoral nerve blockade in conjunction with epidural analgesia after total knee arthroplasty[J]. Anesth Analg, 2005, 101(3): 891-895.
- [55] Zhang W, Hu Y, Tao Y, et al. Ultrasound-guided continuous adductor canal block for analgesia after total knee replacement[J]. Chin Med J (Engl), 2014, 127(23): 4077-4081.
- [56] Hadzic A, Minkowitz HS, Melson TI, et al. Liposome bupivacaine femoral nerve block for postsurgical analgesia after total knee arthroplasty[J]. Anesthesiology, 2016, 124(6): 1372-1383.
- [57] Xiong FJ, Zhao W, Jia SJ, et al. Effect of oral pre-emptive analgesia on pain management after total knee ar-

- throplasty: a protocol for systematic review and meta-analysis[J]. *BMJ Open*, 2023, 13(3): e070998.
- [58] Sattler LN, Walker AT, Kan AJ, et al. Stratification of outpatient physical therapy following total knee arthroplasty: knee arthroplasty physical therapy pathways (KAPPA) nonrandomized controlled trial[J]. *J Arthroplasty*, 2024, 39(7): 1685-1691.
- [59] Gong L, Wang Z, Fan D. Sleep quality effects recovery after total knee arthroplasty (TKA): a randomized, double-blind, controlled study [J]. *J Arthroplasty*, 2015, 30(11): 1897-1901.
- [60] Krenk L, Jennum P, Kehlet H. Postoperative sleep disturbances after zolpidem treatment in fast-track hip and knee replacement[J]. *J Clin Sleep Med*, 2014, 10(3): 321-326.
- [61] Yuan M, Tang T, Ding Z, et al. Analgesic effect of perioperative duloxetine in patients after total knee arthroplasty: a prospective, randomized, double-blind, placebo-controlled trial[J]. *BMC Musculoskelet Disord*, 2022, 23(1): 242.
- [62] YaDeau JT, Mayman DJ, Jules-Elysee KM, et al. Effect of duloxetine on opioid use and pain after total knee arthroplasty: a triple-blinded randomized controlled trial [J]. *J Arthroplasty*, 2022, 37(6): S147-S154.
- [63] Mammoto T, Fujie K, Mamizuka N, et al. Effects of postoperative administration of celecoxib on pain management in patients after total knee arthroplasty: study protocol for an open-label randomized controlled trial [J]. *Trials*, 2016, 17: 45. doi: 10.1186/S13063-015-1106-2.
- [64] Buvaendran A, Kroin JS, Tuman KJ, et al. Effects of perioperative administration of a selective cyclooxygenase 2 inhibitor on pain management and recovery of function after knee replacement: a randomized controlled trial[J]. *JAMA*, 2003, 290(18): 2411-2418.
- [65] Mammoto T, Fujie K, Taguchi N, et al. Short-term effects of early postoperative celecoxib administration for pain, sleep quality, and range of motion after total knee arthroplasty: a randomized controlled trial[J]. *J Arthroplasty*, 2021, 36(2): 526-531.
- [66] Wang HY, Yu GS, Li JH, et al. An updated meta-analysis evaluating limb management after total knee arthroplasty-what is the optimal method? [J]. *J Orthop Surg Res*, 2019, 14(1): 97.
- [67] Wang HY, Yu GS, Li JH, et al. An updated meta-analysis evaluating limb management after total knee arthroplasty-what is the optimal method? [J]. *J Orthop Surg Res*, 2019, 14(1): 97.
- [68] Li B, Wen Y, Liu D, et al. The effect of knee position on blood loss and range of motion following total knee arthroplasty[J]. *Knee Surg Phys Traumatol Arthrosc*, 2012, 20(3): 594-599.
- [69] Wu YG, Zeng Y, Li CF, et al. The effect of post-operative limb positioning on blood loss and early outcomes after primary total knee arthroplasty: a randomized controlled trial[J]. *Int Orthop*, 2019, 43(9): 2083-2091.
- [70] Wu Y, Yang T, Zeng Y, et al. Effect of different post-operative limb positions on blood loss and range of motion in total knee arthroplasty: an updated meta-analysis of randomized controlled trials[J]. *Int J Surg*, 2017, 37: 15-23. doi:10.1016/j.ijsu.2016.11.135.
- [71] Ryan TG, Miladore N, Ryan JT, et al. Influence of limb position on venous blood flow after total knee arthroplasty: a prospective randomized study[J]. *Orthopedics*, 2023, 46(1): 8-12.
- [72] Yang JQ, Yang L, Tan JS, et al. Reduction of blood loss by intra-articular injection of tranexamic acid combined with knee and hip flexion at 45° during primary total knee arthroplasty: a randomized controlled trial[J]. *Orthop Surg*, 2020, 12(6): 1835-1842.
- [73] Jiang C, Lou JQ, Qian WW, et al. Impact of flexion versus extension of knee position on outcomes after total knee arthroplasty: a meta-analysis [J]. *Arch Orthop Trauma Surg*, 2017, 137(2): 257-265.
- [74] Wong J, Ries MD. Total knee arthroplasty//Maxey L, Magnusson J. Rehabilitation for the postsurgical orthopedic patient (third edition) [M] [J]. Elsevier Inc, 2013, 2013: 480-503.
- [75] Banerjee S, Kapadia BH, Issa K, et al. Postoperative blood loss prevention in total knee arthroplasty [J]. *J Knee Surg*, 2013, 26(6): 395-400.
- [76] 张爽, 鲁楠, 李岳. 前交叉韧带重建术后患肢抬高角度对关节肿胀的影响[J]. *中华现代护理杂志*, 2015(23): 2799-2800.
- ZHANG Shuang, LU Nan, LI Yue. Effect of elevation angle of affected limb on joint swelling after anterior cruciate ligament reconstruction [J]. *Chinese Journal of Modern Nursing*, 2015(23): 2799-2800.
- [77] Napier RJ, Bennett D, McConway J, et al. The influence of immediate knee flexion on blood loss and other parameters following total knee replacement [J]. *Bone Joint J*, 2014, 96-B(2): 201-209.
- [78] Li B, Wang G, Wang Y, et al. Effect of two limb positions on venous hemodynamics and hidden blood loss following total knee arthroplasty [J]. *J Knee Surg*, 2017, 30(1): 70-74.
- [79] Quesnot A, Mouchel S, Salah SB, et al. Randomized controlled trial of compressive cryotherapy versus standard cryotherapy after total knee arthroplasty: pain, swelling, range of motion and functional recovery[J]. *BMC*

- Musculoskelet Disord, 2024, 25(1): 182.
- [80] Huang X, Li F, Shi W, et al. Efficacy of perioperative cryotherapy combined with intra-articular injection of tranexamic acid in total knee arthroplasty[J]. Medicine (Baltimore), 2023, 102(29): e34381.
- [81] Brouwers HFG, de Vries AJ, van Zuilen M, et al. The role of computer-assisted cryotherapy in the postoperative treatment after total knee arthroplasty: positive effects on pain and opioid consumption[J]. Knee Surg Phys Traumatol Arthrosc, 2022, 30(8): 2698-2706.
- [82] Río-González A, Cerezo-Téllez E, Gala-Guirao C, et al. Effects of different neck manual lymphatic drainage maneuvers on the nervous, cardiovascular, respiratory and musculoskeletal systems in healthy students[J]. J Clin Med, 2020, 9(12): 4062.
- [83] 王柱, 扈盛, 夏渊, 等. 徒手淋巴引流对全膝关节置换术后康复疗效的 Meta 分析[J]. 中国康复, 2022, 37(8): 493-498.  
WANG Zhu, HU Sheng, XIA Yuan, et al. Effects of manual lymphatic drainage after total knee arthroplasty: a Meta-analysis[J]. Chinese Journal of Rehabilitation, 2022, 37(8): 493-498.
- [84] Wagner M, Wittlinger A, Auffarth A, et al. Manual lymphatic drainage before and after total knee arthroplasty, a randomized controlled trial[J]. J Clin Orthop Trauma, 2024, 51: 102401.
- [85] Cakmak MF, Cigdem-Karacay B. The effect of kinesio taping on edema, pain, and functionality after total knee arthroplasty: a randomised sham-controlled double blinded clinical study[J]. J Orthop Sci, 2024, 29(4): 983-989.
- [86] Yuksel E, Unver B, Karatosun V. Comparison of kinesio taping and cold therapy in patients with total knee arthroplasty: a randomized controlled trial[J]. Clin Rehabil, 2022, 36(3): 359-368.
- [87] Azimi A, Dizaji SR, Tabatabaei FS, et al. Effect of postoperative kinesio taping on knee edema, pain, and range of motion after total knee arthroplasty and anterior cruciate ligament reconstruction: a systematic review and meta-analysis of randomized clinical Trials [J]. JBJS Rev, 2024, 12(3): e23.00221.
- [88] Windisch C, Brodt S, Röhner E, et al. Effects of Kinesio taping compared to arterio-venous Impulse System™ on limb swelling and skin temperature after total knee arthroplasty[J]. Int Orthop, 2017, 41(2): 301-307.
- [89] Tornatore L, De Luca ML, Ciccarello M, et al. Effects of combining manual lymphatic drainage and Kinesiotaping on pain, edema, and range of motion in patients with total knee replacement: a randomized clinical trial [J]. Int J Rehabil Res, 2020, 43(3): 240-246.
- [90] Herbold JA, Bonistall K, Blackburn M, et al. Randomized controlled trial of the effectiveness of continuous passive motion after total knee replacement [J]. Arch Phys Med Rehabil, 2014, 95(7): 1240-1245.
- [91] Gil-González S, Barja-Rodríguez RA, López-Pujol A, et al. Continuous passive motion not affect the knee motion and the surgical wound aspect after total knee arthroplasty[J]. J Orthop Surg Res, 2022, 17(1): 25.
- [92] Rui W, Long G, Li G, et al. Effects of ethyl chloride spray on early recovery after total knee arthroplasty: a prospective study[J]. J Orthop Sci, 2017, 22(1): 89-93.
- [93] Mistry JB, Elmallah RD, Bhav A, et al. Rehabilitative guidelines after total knee arthroplasty: a review [J]. J Knee Surg, 2016, 29(3): 201-217.
- [94] Gu S, Chen YE, Lei M, et al. Effect of different application duration of a venous foot pump on prevention of venous thromboembolism after hip and knee arthroplasty: a multicenter prospective clinical trial[J]. BMC Musculoskelet Disord, 2023, 24(1): 931.
- [95] Husby VS, Foss OA, Husby OS, et al. Randomized controlled trial of maximal strength training vs. standard rehabilitation following total knee arthroplasty[J]. Eur J Phys Rehabil Med, 2018, 54(3): 371-379.
- [96] Fukaya T, Mutsuzaki H, Yoshikawa K, et al. Effect of training with the hybrid assistive limb on gait cycle kinematics after total knee arthroplasty [J]. Geriatr Orthop Surg Rehabil, 2021, 12: 21514593211049075. doi:10.1177/21514593211049075.
- [97] Pua YH, Ong PH. Association of early ambulation with length of stay and costs in total knee arthroplasty: retrospective cohort study [J]. Am J Phys Med Rehabil, 2014, 93(11): 962-970.
- [98] Dávila Castrodad IM, Recai TM, Abraham MM, et al. Rehabilitation protocols following total knee arthroplasty: a review of study designs and outcome measures[J]. Ann Transl Med, 2019, 7(Suppl 7): S255.
- [99] Yue C, Zhang X, Zhu Y, et al. Systematic review of three electrical stimulation techniques for rehabilitation after total knee arthroplasty [J]. J Arthroplasty, 2018, 33(7): 2330-2337.
- [100] WANG Ninghua, XIE Bin, WEI Xing, et al. A clinical controlled study of immediate analgesia effect of TENS on post-operative pain after total knee replacement[J]. Chinese Journal of Rehabilitation Medicine, 2005, 20(3): 188-190.
- [101] Rakel BA, Zimmerman BM, Geasland K, et al. Transcutaneous electrical nerve stimulation for the control of pain during rehabilitation after total knee arthroplasty: a randomized, blinded, placebo-controlled trial [J]. Pain, 2014, 155(12): 2599-2611.
- [102] DeSantana JM, Walsh DM, Vance C, et al. Effective-

- ness of transcutaneous electrical nerve stimulation for treatment of hyperalgesia and pain[J]. *Curr Rheumatol Rep*, 2008, 10(6): 492-499.
- [103] Liddle AD, Whitehouse SL, Deehan DJ, et al. Early physiotherapy following total knee replacement: a randomized controlled trial[J]. *J Arthroplasty*, 2010, 25(6): 889-894.
- [104] Pincus T, Callaghan JJ, Lau E, et al. Enhanced recovery after surgery (ERAS) for total knee arthroplasty: a systematic review and meta-analysis[J]. *Clin Orthop Relat Res*, 2017, 475(10): 2622-2634.
- [105] Huang Y, Li X, Wang X, et al. Early versus late physical therapy for total knee arthroplasty: a systematic review and meta-analysis[J]. *J Arthroplasty*, 2016, 31(11): 2542-2548.
- [106] Taunton MJ, Whitehouse SL, Liddle AD, et al. The effect of quadriceps muscle weakness on the gait of patients after total knee replacement[J]. *J Bone Joint Surg Br*, 2011, 93(1): 71-76.
- [107] Bistolfi A, Zanovello J, Ferracini R, et al. Evaluation of the effectiveness of neuromuscular electrical stimulation after total knee arthroplasty: a meta-analysis[J]. *Am J Phys Med Rehabil*, 2018, 97(2): 123-130.
- [108] Stevens-Lapsley JE, Balter JE, Wolfe P, et al. Early neuromuscular electrical stimulation to improve quadriceps muscle strength after total knee arthroplasty: a randomized controlled trial[J]. *Phys Ther*, 2012, 92(2): 210-226.
- [109] Huang CH, Yeh ML, Chen FP, et al. Low-level laser acupuncture reduces postoperative pain and morphine consumption in older patients with total knee arthroplasty: a randomized placebo-controlled trial[J]. *J Integr Med*, 2022, 20(4): 321-328.
- [110] Martini D, Sconza C, Di Matteo B, et al. Early application of extracorporeal shock wave therapy improves pain control and functional scores in patients undergoing total knee arthroplasty: a randomized controlled trial[J]. *Int Orthop*, 2023, 47(11): 2757-2765.
- [111] Li R, Du JB, Yang K, et al. Effectiveness of motor imagery for improving functional performance after total knee arthroplasty: a systematic review with meta-analysis[J]. *J Orthop Surg Res*, 2022, 17(1): 65.
- [112] Moukarzel M, Guillot A, Di Rienzo F, et al. The therapeutic role of motor imagery during the chronic phase after total knee arthroplasty: a pilot randomized controlled trial[J]. *Eur J Phys Rehabil Med*, 2019, 55(6): 806-815.
- [113] Groot L, Latijnhouwers DAJM, Reijman M, et al. Recovery and the use of postoperative physical therapy after total hip or knee replacement[J]. *BMC Musculoskeletal Disord*, 2022, 23(1): 666.
- [114] Tanaka R, Hayashizaki T, Taniguchi R, et al. Effect of an intensive functional rehabilitation program on the recovery of activities of daily living after total knee arthroplasty: a multicenter, randomized, controlled trial[J]. *J Orthop Sci*, 2020, 25(2): 285-290.
- [115] Rognsvåg T, Bergvad IB, Furnes O, et al. Exercise therapy, education, and cognitive behavioral therapy alone, or in combination with total knee arthroplasty, in patients with knee osteoarthritis: a randomized feasibility study[J]. *Pilot Feasibility Stud*, 2024, 10(1): 43.
- [116] Adebero T, Omana H, Somerville L, et al. Effectiveness of prehabilitation on outcomes following total knee and hip arthroplasty for osteoarthritis: a systematic review and meta-analysis of randomized controlled trials[J]. *Disabil Rehabil*, 2024; 1-20. doi:10.1080/09638288.2024.2313128.
- [117] 胡惠琴, 常晓雪. 高龄、失能、失独老人住宅适老化改造需求探究——以北京市东城区为例[J]. *建筑实践*, 2018, 1(2): 5.
- [118] Khatri C, Dhaif F, Ellard D, et al. What recovery domains are important following a total knee replacement? A qualitative, interview-based study[J]. *BMJ Open*, 2024, 14(5): e080795.
- [119] Yang X, Li GH, Wang HJ, et al. Continuous passive motion after total knee arthroplasty: a systematic review and meta-analysis of associated effects on clinical outcomes[J]. *Arch Phys Med Rehabil*, 2019, 100(9): 1763-1778.
- [120] Rodríguez-Merchán EC. The stiff total knee arthroplasty: causes, treatment modalities and results[J]. *EFORT Open Rev*, 2019, 4(10): 602-610.
- [121] Lei YT, Xie JW, Huang Q, et al. Benefits of early ambulation within 24 h after total knee arthroplasty: a multicenter retrospective cohort study in China[J]. *Mil Med Res*, 2021, 8(1): 17.
- [122] Millett PJ, Williams RJ 3rd, Wickiewicz TL. Open debridement and soft tissue release as a salvage procedure for the severely arthrobrotic knee[J]. *Am J Sports Med*, 1999, 27(5): 552-561.
- [123] Sheiko G, Karyakin NN, Belova AN, et al. Efficacy and safety of remote physical rehabilitation in patients with hip or knee replacement: a prospective randomized comparative study[J]. *Vestnik vosstanovitel'noj mediciny (Online)*, 2024, 22(5): 40-47.
- [124] Booth MW, Riegler V, King JS, et al. Patients' perceptions of remote monitoring and app-based rehabilitation programs: a comparison of total hip and knee arthroplasty[J]. *J Arthroplasty*, 2023, 38(7s): S39-S43.
- [125] Bell KM, Onyeukwu C, Smith CN, et al. A portable

- system for remote rehabilitation following a total knee replacement; a pilot randomized controlled clinical study [J]. *Sensors (Basel)*, 2020, 20(21): 6118.
- [126] 李纳平, 杨少锋, 邝高艳, 等. 针灸辅助全膝关节置换术后康复有效性的 Meta 分析[J]. *康复学报*, 2022, 32(3): 263-273.
- LI Naping, YANG Shaofeng, KUANG Gaoyan, et al. Meta analysis of effectiveness on acupuncture assisted rehabilitation after total knee arthroplasty [J]. *Rehab Med*, 2022, 32(3): 263-273.
- [127] 关识言, 陈述祥, 刘彦, 等. 针刺对人工全膝关节置换术后患者早期恢复疗效的 Meta 分析[J]. *中医药通报*, 2021, 20(1): 52-57.
- GUAN Shiyan, CHEN Shuxiang, LIU Yan, et al. Meta-analysis of the effect of acupuncture on early recovery of patients after total knee arthroplasty [J]. *Traditional Chinese Medicine Journal*, 2021, 20(1): 52-57.
- [128] 黄涌, 邓宏平, 黄丽, 等. 耳穴压籽联合经皮穴位电刺激对老年膝关节置换术后急性疼痛的作用[J]. *中华临床医师杂志(电子版)*, 2023, 17(3): 285-290.
- [129] 杨锋, 张桂鑫, 杨冯春, 等. 耳穴疗法改善全膝关节置换术后疼痛系统评价[J]. *中国中医药图书情报杂志*, 2023, 47(4): 102-109.
- YANG Feng, ZHANG Guixin, YANG Fengchun, et al. Systematic review and meta-analysis of auricular acupuncture therapy for improvement of postoperative pain after total knee replacement[J]. *Chinese Journal of Library and Information Science for Traditional Chinese Medicine*, 2023, 47(4): 102-109.
- [130] Fu Z, Xu C, Wang Y, et al. Traditional chinese acupuncture massage of the quadriceps femoris can relieve flexion pain after undergoing total knee arthroplasty[J]. *Evid Based Complement Alternat Med*, 2022, 2022: 1091174.
- [131] 张立创, 高华利, 王竞超, 等. 筋骨并重理筋手法干预全膝关节置换术后患者股四头肌功能的加速康复[J]. *中国组织工程研究*, 2023, 27(9): 1383-1389.
- ZHANG Lichuang, GAO Huali, WANG Jingchao, et al. Effect of tendon manipulation with equal emphasis on muscles and bones on accelerating the functional rehabilitation of quadriceps femoris after total knee arthroplasty[J]. *Chinese Journal of Tissue Engineering Research*, 2023, 27(9): 1383-1389.
- [132] 张哲, 马辉, 康一凡, 等. 本体感觉训练在全膝关节置换术后康复中的应用价值[J]. *中华关节外科杂志(电子版)*, 2016, 10(4): 376-380.
- ZHANG Zhe, MA Hui, KANG Yifan, et al. Application of proprioception training in rehabilitation after total knee replacement[J]. *Chinese Journal of Joint Surgery(Electronic Edition)*, 2016, 10(4): 376-380.
- [133] 卢岩岩, 许学猛, 刘文刚, 等. 本体感觉和平衡训练对全膝关节置换后膝关节功能恢复影响的 Meta 分析[J]. *中国组织工程研究*, 2019, 23(16): 2601-2607.
- LU Yanyan, XU Xuemeng, LIU Wengang, et al. Effect of proprioceptive and balance training on rehabilitation of knee joint after total knee arthroplasty: a meta-analysis[J]. *Chinese Journal of Tissue Engineering Research*, 2019, 23(16): 2601-2607.
- [134] 陈巧玲, 黄双英, 封蕾, 等. 穴位按压联合温灸干预全膝关节置换术后下肢肿胀临床观察[J]. *上海针灸杂志*, 2015, 34(10): 990-992.
- CHEN Qiaoling, HUANG Shuangying, FENG Lei, et al. Clinical observations on acupoint pressing plus gentle moxibustion for intervention in lower limb swelling after total knee arthroplasty[J]. *Shanghai Journal of Acupuncture and Moxibustion*, 2015, 34(10): 990-992.
- [135] 唐莹. 揸针埋针在预防骨科全麻术后恶心呕吐的效果观察[J]. *双足与保健*, 2019, 28(16): 39-40.
- TANG Ying. Observation on the effect of pressing and burying needles in preventing nausea and vomiting after orthopedic general anesthesia[J]. *Biped and Health*, 2019, 28(16): 39-40.
- [136] Liu N, Liu G, Chang X, et al. Combining various acupuncture therapies with multimodal analgesia to enhance postoperative pain management following total knee arthroplasty: a network meta-analysis of randomized controlled trials[J]. *Front Neurol*, 2024, 15: 1361037. doi:10.3389/fneur.2024.1361037.ecouctionu.2024.

(编辑:徐苗蓁)