

# 内侧半月板外突的研究进展

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**摘 要** 内侧半月板外突可导致半月板的生理功能丧失, 从而引起膝骨关节炎等疾病。目前内侧半月板外突的最佳疗法尚存在争议, 而内侧半月板中心化治疗能恢复内侧半月板的生理功能, 是目前运动医学的研究热点。本文对内侧半月板外突进行了概述, 并从病因、继发病理改变、治疗方法 3 个方面对内侧半月板外突的研究进展进行了综述。

**关键词** 半月板; 胫骨; 半月板外突; 综述

半月板是膝关节的重要解剖结构, 其形态和位置发生异常改变可影响膝关节功能。膝关节冠状位 MRI 上内侧半月板向外侧移位超出胫骨平台边缘即内侧半月板外突, 这种改变可影响内侧半月板的生理功能, 引起膝关节不稳定, 继而造成关节软骨损伤<sup>[1-5]</sup>。内侧半月板外突的治疗方法较多, 治疗不当可加速关节软骨退变。目前内侧半月板外突的最佳治疗方法尚存在争议, 其中内侧半月板中心化治疗是研究热点之一。本文就内侧半月板外突的研究进展综述如下。

## 1 内侧半月板外突概述

半月板主要由含有弹性蛋白、蛋白聚糖及 I 型胶原纤维的纤维软骨组成, 半月板内部的胶原纤维呈环状和放射状排列, 内侧半月板较外侧半月板大, 且外观呈“C”形、前部狭窄而后部略宽<sup>[6-7]</sup>。内侧半月板的下表面相对平滑, 与胫骨平台相接; 上表面稍微凹陷, 与股骨髁相吻合<sup>[8-9]</sup>。半月板具有填充膝关节、减小关节软骨应力、吸收震荡等作用, 是维持膝关节稳定的重要结构<sup>[10-11]</sup>。半月板可随着膝关节活动而轻微移动(移动距离一般 < 3 mm), 以保持半月板与股骨髁之间、半月板与胫骨平台之间良好贴合, 从而起到保护膝关节软骨的作用<sup>[12]</sup>。MRI 是内侧半月板外突的首选影像学检查方法, 膝关节冠状位 MRI 上内侧半月板外缘超出胫骨平台外缘的距离  $\geq 3$  mm 即可诊断为内侧半月板外突<sup>[13-14]</sup>。

## 2 内侧半月板外突的病因

**2.1 内侧半月板自身结构异常** 半月板内部的环形胶原纤维排列方式发生异常改变, 可导致半月板的环

形张力下降<sup>[9-10, 15]</sup>。半月板血管区边缘撕裂后, 可出现关节积液, 造成半月板相对性向外移位<sup>[9]</sup>。半月板呈放射状撕裂后, 在负重状态下内侧半月板的环形张力完全消失, 内侧半月板向外突出的程度增加<sup>[5, 8, 10]</sup>。此外, 内侧半月板后根部撕裂也可造成内侧半月板外突<sup>[1, 8, 11, 16-19]</sup>。各种原因引起的膝关节稳定性下降, 可使负重状态下内侧半月板的应力明显增加, 容易引起内侧半月板损伤, 从而使内侧半月板外突的风险增高<sup>[20-21]</sup>。

**2.2 内侧半月板相邻组织损伤** 内侧半月板与关节囊和前后交叉韧带相连, 若关节囊和前后交叉韧带受损, 内侧半月板可因失去限制而移位, 从而造成内侧半月板外突<sup>[7, 9]</sup>。膝关节处于屈曲位时, 半月板向后移动, 由于关节囊在内侧半月板的附着较为牢固, 内侧半月板的活动度较小, 容易受到损伤<sup>[3, 22]</sup>。膝横韧带是连接内外侧半月板的重要结构, 可以限制半月板移位<sup>[23-24]</sup>。半月板后根部是半月板前角和后角在胫骨平台的附着部分, 具有维持半月板的正常解剖结构和位置等作用<sup>[25]</sup>。Krych 等<sup>[26-28]</sup>研究发现, 半月板后根部撕裂可减弱半月板的环形张力, 在负重状态下半月板会向前或外侧移位, 认为内侧半月板外突与内侧半月板后根部撕裂高度相关。

**2.3 其 他** 内侧半月板外突还与年龄、性别及高体质量指数有关。Ding 等<sup>[29-30]</sup>研究发现, 随着年龄增长, 内侧半月板外突的发生率及移位程度均明显增加。50 岁以上人群更容易发生内侧半月板外突, 而且随着年龄增长, 内侧半月板的外突程度也不断增加<sup>[31-32]</sup>。Bloeker 等<sup>[33-34]</sup>研究发现, 女性更容易发生内侧半月板外突。而内侧半月板外突也是中年女性发生膝骨关节炎(knee osteoarthritis, KOA)的危险

因素<sup>[35-36]</sup>。高体质量指数可使内侧半月板应力增加,容易发生内侧半月板损伤,且会加速软骨退变,导致下肢力线改变,从而引起内侧半月板外突<sup>[5,31-32,36]</sup>。将体质量指数维持在合适范围内,有助于预防或改善内侧半月板外突<sup>[34-35,37]</sup>。

### 3 内侧半月板外突的继发病理改变

**3.1 KOA** 半月板的功能或解剖结构异常可导致 KOA 的发生<sup>[4,7,38]</sup>。内侧半月板外突可破坏膝关节的稳定性,使股骨髁与胫骨平台发生撞击,引起软骨和软骨下骨损伤,从而引起 KOA<sup>[39-40]</sup>。软骨下骨的应力分布不均可使软骨下骨出现微骨折,微骨折可引起骨重塑,而骨重塑可导致软骨下骨硬化,软骨下骨硬化后软骨下骨的缓冲应力能力和吸收震荡能力减退,会进一步增加关节软骨的应力,最终加重关节软骨的损伤程度<sup>[41-43]</sup>。内侧半月板外突可影响膝关节内侧的应力分布,使关节软骨的应力增加,可加速膝关节退变,引起 KOA<sup>[44]</sup>。

**3.2 膝内翻** 膝内翻可增加内侧半月板外突的风险,并且会影响半月板手术的手术效果<sup>[45]</sup>。膝内翻可造成下肢力线异常,使膝关节内侧应力分布不均,从而增加内侧半月板外突的风险<sup>[24]</sup>。内侧半月板外突的风险可随膝内翻程度的增加而增加,进而加速 KOA 的病情进展<sup>[5,35]</sup>。内侧半月板外突可使内侧关节间隙狭窄程度增加,从而加重膝内翻程度<sup>[10,29]</sup>。膝关节内侧间隙狭窄多继发于内侧半月板外突而非软骨退变,但内侧半月板外突却可加速软骨退变<sup>[13,29,46]</sup>。

### 4 内侧半月板外突的治疗方法

内侧半月板外突治疗不当可加速 KOA 进展,但目前内侧半月板外突尚无最佳疗法<sup>[3]</sup>。近年来有研究<sup>[12,47]</sup>发现,采用关节镜技术修复内侧半月板,可恢复内侧半月板的功能,有利于维持膝关节的稳定,从而延缓软骨退变进程。目前对于下肢力线无异常的内侧半月板外突患者,手术治疗方法主要有经骨隧道缝合固定和锚钉缝合固定两种。经胫骨骨隧道缝合固定技术是在关节镜下,于胫骨近端通过前交叉韧带定位器用空心钻钻出骨隧道,然后在适当张力下将半月板缝合固定在胫骨平台上<sup>[48-52]</sup>。锚钉缝合固定技术是在内侧半月板附着区植入锚钉,用锚钉的缝线将内侧半月板缝合固定在胫骨平台上;该技术需要建立一个合适的内侧入路,并且需将锚钉植入胫骨平台骨皮质内<sup>[53-55]</sup>。虽然锚钉缝合固定无需建立骨隧道,避

免了经胫骨骨隧道缝合固定的缝线磨损和“蹦极效应”,但手术入路的视野不佳,有血管神经损伤的风险。

半月板与下肢力线异常的关系密切,切除半月板会导致下肢力线异常,而下肢力线异常也会导致半月板外突。膝内翻和内侧关节间隙狭窄是造成下肢力线异常的常见原因,也是影响关节镜术后半月板功能恢复的重要因素<sup>[56]</sup>。胫骨高位截骨术可改变下肢力线,把膝关节的受力点从膝关节内侧间室转移到中间或外侧间室,从而通过减轻膝关节内侧软骨和半月板的应力改善内侧半月板外突<sup>[57-58]</sup>。对于合并膝内翻的内侧半月板外突患者,可采用胫骨高位截骨联合内侧半月板中心化治疗。胫骨高位截骨可纠正下肢力线异常,减轻内侧间室负荷,有利于内侧半月板的中心化。在矫正膝内翻畸形后再进行内侧半月板中心化,并尽量保留内侧半月板组织,有利于恢复内侧半月板的生理功能,从而延缓 KOA 的病理进程。

### 5 小 结

内侧半月板外突的病因较多,以半月板或半月板相邻组织损伤最为多见。内侧半月板外突可造成半月板生理功能丧失,最终发展为 KOA。因此如何处理内侧半月板外突,恢复内侧半月板的生理功能,是亟待解决的问题。目前,内侧半月板外突的诊断和治疗尚无统一标准,未来还需通过高质量临床研究进行深入探讨,从而使内侧半月板外突的诊疗更加规范。

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