

# 盘状半月板撕裂的研究现状

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## 摘要

盘状半月板是月板的一种畸形, 与正常半月板相比体部更大且肥厚, 呈盘状, 因此被称为盘状半月板。目前, 大量的研究结果表明盘状半月板与正常半月板之间不仅在形态学上存在差异, 盘状半月板的微观结构及其构成也发生明显改变, Kocher等通过对盘状半月板的组织学研究, 认为盘状半月板较正常半月板厚、周围血管密度低、胶原纤维数量少、其中的胶原无组织环向网络削弱半月板的超微结构等因素共同导致了半月板更易损伤和撕裂, Masquijo等人的研究也证实了这一观点。盘状半月板的胶原纤维含量更少且空间排布散乱, 这就提示在半月板的发育过程中, 可能存在基因突变或者在基因表达调控的过程中出现异常, 家族型盘状半月板的病例及双侧盘状半月板的病例都可以很好地证实这一观点。盘状半月板多好发于外侧, 而膝关节外侧盘状半月板(discoid lateral meniscus, DLM)又是盘状半月板最常见的变异类型, 膝关节内侧盘状半月板较为少见。盘状半月板在东亚人种中发病率高, 据报道, 盘状半月板在日本发病率为16.6%, 在韩国发病率为10.9%, 但是在高加索人种中发病率很低(0.4%~5%)。并且, DLM双膝同患的概率为79%~97%, 我国人口基数大, 故DLM患者数量较多, 针对于盘状半月板的诊断、治疗及研究就显得尤为重要。

## 关键词

盘状半月板, 外侧盘状半月板, 盘状半月板撕裂, 半月板撕裂, DLM, 综述

# Research Status of Discoid Meniscus Tear

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## Abstract

Discoid meniscus is a malformation of the meniscus of the moon, which is larger and thicker than the normal meniscus and is disc-shaped, so it is called discoid meniscus. At present, a large number of research results show that there are not only morphological differences between discoid meniscus and normal meniscus, but also significant changes in the microstructure and composition of discoid meniscus. Kocher *et al.*, through histological study of discoid meniscus, believed that discoid meniscus was more prone to damage and tear than normal meniscus, with lower density of peripheral blood vessels, fewer collagen fibers, and the collagen-disorganized circumferential network which weakened the ultrastructure of the meniscus. Research by Masquijo *et al.* supports this view too. Discoid meniscus has less collagen fiber content and scattered spatial arrangement, which suggests that there may be gene mutations or abnormalities in the regulation of gene expression during the development of meniscus, which can be well confirmed in familial cases of discoid meniscus and bilateral cases of discoid meniscus. The discoid meniscus is more likely to occur on the lateral side, and discoid lateral meniscus (DLM) is the most common variant of discoid lateral meniscus. The prevalence of discoid meniscus is high in East Asian populations, with 16.6% reported in Japan and 10.9% in Korea, but the incidence of discoid meniscus is low (0.4% to 5%) in Caucasians. Moreover, the probability of both knees suffering from DLM is 79%~97%, and the population base of China is large, so the number of DLM patients is large, and the diagnosis, treatment and research on discoid meniscus are particularly important.

## Keywords

Discoid Meniscus, Discoid Lateral Meniscus, Discoid Meniscus Tear, Discoid Meniscus, DLM, Review

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## 1. 引言

盘状半月板是月板的一种畸形，与正常半月板相比体部更大且肥厚，呈盘状，因此被称为盘状半月板。目前，大量的研究结果表明盘状半月板与正常半月板之间不仅在形态学上存在差异[1] [2]，盘状半月板的微观结构及其构成也发生明显改变，Kocher 等[3]通过对盘状半月板的组织学研究，认为盘状半月板较正常半月板厚、周围血管密度低、胶原纤维数量少、其中的胶原无组织环向网络削弱半月板的超微结构等因素共同导致了盘状半月板更易损伤和撕裂，Masquijo [4]等人的研究也证实了这一观点。盘状半月板的胶原纤维含量更少且空间排布散乱[5]，这就提示在半月板的发育过程中，可能存在基因突变或者在基因表达调控的过程中出现异常[6]，家族型盘转半月板的病例及双侧盘状半月板的病例[7] [8]都可以很好地证实这一观点。盘状半月板多好发于外侧，而膝关节外侧盘状半月板(discoid lateral meniscus, DLM)又是盘状半月板最常见的变异类型，膝关节内侧盘状半月板较为少见[9] [10]。盘状半月板在东亚人种中发病率高，据报道，盘状半月板在日本发病率为 16.6% [11]，在韩国发病率为 10.9%，但是在高加索人种中发病率很低(0.4%~5%)。并且，DLM 双膝同患的概率为 79%~97% [12] [13]，我国人口基数大，故 DLM 患者数量较多，针对于盘状半月板的诊断、治疗及研究就显得尤为重要。

## 2. 盘状半月板的类型及撕裂类型

对与盘状半月板的分型,目前被广泛认可的是 Watanabe 分型,关节镜下将盘状半月板分为 3 型, I 型:完全盘状半月板,是指外侧半月板异常增厚,胫骨平台被半月板组织完全包绕,半月板附件正常。II 型:不完全盘状半月板,是指外侧半月板异常增厚,胫骨平台被半月板组织包绕 $>80\%$ ,但 $<100\%$ ,半月板附件正常。III 型:Wrisbeg 韧带型,是指外侧半月板后角异常增厚,仅有后部半月板附件与 Wrisberg 韧带相连,在形态学和组织学上与正常半月板相似,发病率仅为 $0.2\%$  [14]。随着科学技术的发展,人们对盘状半月板的 MRI 及关节镜检查有了更加深入的研究,Ahn 等人[15]提出了一种基于 MRI 的分类,根据半月板是否发生移位,将 DLM 分为 4 类(无移位、前中央移位、后中央移位和中央移位),无位移的患者所占比例更高一些,但位移后盘状半月板撕裂的概率更高一些。Ryu [16]又在 Watanabe 分型的基础上,在关节镜下增加了两种分型,即:环形盘状半月板和双层盘状半月板。目前,并没有学者将盘状半月板的撕裂类型作以详细的划分与界定,由于盘状半月板是半月板的一种异常形态,我们可将半月板的撕裂类型的定义应用于盘状半月板。O'connor 将半月板撕裂的类型分为 8 种:纵向、水平、斜向、径向、皮瓣、复杂、退行性和间质性,这其中,水平撕裂更为常见[3] [17]。为了更好的满足临床实践,Bin [18]将撕裂类型的分类进行了改进,分为简单水平、复杂水平、纵向、放射状、退行性和复杂撕裂。目前研究表明,盘状半月板的类型与撕裂类型可能存在一定的联系[15]。Bin [18]等人认为单纯水平撕裂只出现在完整型盘状半月板中,放射状撕裂、退行性撕裂和复杂撕裂只出现在不完整型盘状半月板中。在纵向撕裂中,撕裂类型与盘状半月板的类型没有相关性。Yamaguchi N [19]等人的研究认为,完全性盘状半月板中单纯水平撕裂和复杂水平撕裂多见,不完全性盘状半月板中放射状撕裂和复杂撕裂多见。

## 3. 盘状半月板的诊断

对于盘状半月板的诊断,首先考虑的便是结合临床症状和影像学表现。盘状半月板通常不会出现症状,如果出现边缘不稳定或者撕裂,则会出现关节交锁、关节弹响、膝关节疼痛等症状[20] [21];可进行的特殊查体有:强力过伸或过屈试验、McMurray 试验、重力试验和研磨试验等。这些实验可以初步判断膝关节病变的部位,但是这些结果也可以继发于关节软骨或韧带损伤,因此,影像学检查就显得尤为重要。影像学检查主要包括 X 线片、MRI 检查以及膝关节超声检查。X 线片是骨科最常用的检查方法,在 DLM 患者的膝关节前后位 X 线片中,可以发现股骨外侧髁与胫骨平台的间隙明显增宽,而对侧膝关节间隙正常或缩窄,这种特殊的影像学现象也被称为锁扣征(或杯口征)。Hino 等[22]通过对 DLM 患者膝关节 X 线片的测量,发现胫骨髁间隆起的宽度  $>13.9\text{ mm}$  和内侧坡度角  $>17.1^\circ$ 对完全型盘状半月板的诊断具有指导意义。Milewski 等[23]通过比较 DLM 患者和正常人的膝关节 X 线片,发现测量腓骨头的高度和外侧膝关节间隙的宽度也可以辅助诊断盘状半月板。Lu 等[24]研究认为外侧髁凸角增大也可能提示外侧盘状半月板的存在。以上等人研究结果的仅适用于完全型 DLM 患者。因此,X 线检查对盘状半月板具有间接诊断意义,特异性并不高,还需要 MRI 进一步检查[25]。在 MRI 检查结果上,目前骨科医生普遍认同的诊断标准:在连续 3 个或 3 个以上  $5\text{ mm}$  厚的矢状面图像上显示半月板前、后角相连,这种表现也被称为“领结征”。针对如何区分完全型盘状半月板和不完整型盘状半月板,Choi 等[26]通过大量测量研究得出,在 MRI 图像上,测量外侧半月板最小宽度与胫骨最大宽度的比值是否 $\geq 0.32$ ,就可以区分完全型盘状半月板和不完整型盘状半月板。Xu 等[27]通过在 MRI 图像上测量后外侧髁角与后内侧髁角的度数,将盘状半月板患者与正常半月板患者的股骨外侧髁形态进行比较后发现,完全型 DLM 患者的股骨后外侧髁存在明显的发育不良,并通过大量测量结果研究得出,该测量技术对完全型 DLM 的诊断具有较高的特异度和敏感度,即后外侧髁角  $<18.705^\circ$  和后外侧髁角/后内侧髁角  $<0.798^\circ$  就可以诊断为完全型盘状半月板。对于未发生撕裂的盘状半月板,以上这些诊断方法所得出的诊断还是比较明确的。但是,当盘

状半月板存在较大的撕裂时,半月板的形态就会有所改变,半月板的中心可能随之消失,以上的诊断标准就容易忽视对盘状半月板的诊断[28]。针对撕裂的盘状半月板,我们也有独特的诊断标准,大多数学者认为,在MRI结果上,加以精确地测量,可以很好的诊断撕裂之后的盘状半月板。同时,我们也将未撕裂的盘状半月板与撕裂后的盘状半月板在MRI结果上进行比较,结果显示为损伤后的盘状半月板在矢状面形态发生了变化,其前角高度和前后径宽度增加,而其前缘至胫骨前缘的距离却减小,这表明损伤后的盘状半月板有前向移位的趋势[29]。随着超声技术的不断提高,针对一些不能很好配合核磁检查的儿童,超声下测量半月板的形态,对于盘状半月板的诊断也存在一定的指导意义[30]。此外,还有一种对盘状半月板及其撕裂诊断最为精确、临床上也最为少见的检查方法,即关节镜下诊断盘状半月板[31],因此检查有创,临床上很少有医生将关节镜检查作为术前诊断方法,针对于有需要行关节镜手术的患者,关节镜的术中诊断可对盘状半月板的术前诊断加以佐证。

#### 4. 盘状半月板撕裂的治疗

根据目前的研究进展,对于无症状的外侧盘状半月板患者,大多数学者建议非手术治疗[3][32][33],因为膝关节已经适应了半月板的盘状结构[34],更推荐物理治疗并避免超负荷运动[31][35][36]。对于偶然发现的无症状的、稳定的盘状半月板损伤的患者,是否需要进行治疗仍存在争议。对于有症状的DLM患者,如果检查时一旦发现盘状半月板撕裂或结构不稳,由于盘状半月板的结构特点导致其易因高强度、长时间的负重运动而发生撕裂,撕裂口可能进一步扩大,导致膝关节出现疼痛、畸形愈合、绞锁等症状,进而发展成膝关节慢性损伤,最终致残,手术治疗显得尤为重要。Simon等人通过对DLM稳定性的分类研究发现,DLM患者膝关节活动受限有所好转的过程,并不意味着DLM的稳定性较前改善,反而说明DLM不稳定的加重,手术指征更加明确。在手术时机的选择方面,Kinoshita[37]等通过手术前后核磁图像的对比评估发现,早期对DLM患者行半月板成形术,可有效减轻胫骨外侧平台后倾角的增大以及股骨外侧髁最低点的外移。

在半月板损伤的手术治疗中,关节镜下的微创手术几乎取代了传统开放式手术[38]。目前,对于盘状半月板撕裂的手术方式主要有4种,即半月板全切除术、半月板部分切除术、半月板修复术、半月板重建术。在20世纪80年代,半月板全切除术被首次提出[39],而术后的长期结果不佳[40]。此后的生物力学研究发现半月板全切除术会导致关节软骨接触面积减少,局部峰值接触压力大幅增加[41],股骨软骨及胫骨软骨的接触应力也会大幅增加[42],反而增大了膝关节的负荷[43],因而临床上很少应用。关节镜下半月板部分切除术(Arthroscopic partial meniscectomy, APM)的优点是手术速度快,复发率低,短期效果好[44][45],因此成为了治疗半月板撕裂最常用的外科手术。但其也存在一定的局限性,如会加速胫骨平台软骨及股骨软骨的退化,也会一定程度上加速髌股关节软骨退化[46]。因为APM可以轻微的改变膝关节内的应力情况,对于术前即存在膝关节内翻或外翻的DLM患者,需慎重选择此手术方式[47]。对于APM中,半月板保留的最佳宽度,Liu[48]的研究表明,保留半月板宽度为8~10mm可为膝关节提供较好的生物力学环境,可以有效降低常规手术中过度半月板切除术导致的早期膝关节退变和外翻的风险。进行APM的患者,必须对不稳定的盘状半月板边缘进行固定[49]。半月板修复术也是临床上应用比较多的治疗方法,目前针对不同类型的盘状半月板撕裂,修复方法也存在个体化的差异。当半月板后角或体部发生撕裂时,可采用Fast-Fix缝合器进行内层缝合固定,并根据撕裂类型选择具体缝合方式[50]。当半月板前角撕裂时,普遍采用从外向内缝合的方法,需要借助PDS-II缝线和12号腰穿针完成缝合,经济高效,若合并腓肌腱裂孔区撕裂,需避开腓肌腱进行缝合,以免损伤腓肌腱或将腓肌腱与半月板缝合在一起。半月板重建术也是治疗盘状半月板撕裂的一种重要手术方式,半月板移植术能减轻患者膝关节疼痛、预防膝关节外侧间室骨关节炎的发生,对关节软骨具有一定的保护作用[51]。目前的研究表明,治疗盘状半月板撕裂的



手术会在一定程度上改变下肢力线[52], 为了避免盘状半月板损伤引起的下肢力线改变, 可在术中尽可能多地保留半月板或行同种异体半月板移植术。

## 5. 盘状半月板及其撕裂的预后和评估

无论是盘状半月板还是正常的半月板, 撕裂后都会对膝关节软骨造成一定程度上的损伤, 盘状半月板撕裂后导致膝关节软骨损伤概率提升至 200% [53], 软骨的损伤则是导致膝关节骨关节炎的重要机制, 不同撕裂类型的盘状半月板, 对膝关节的远期影响也存在差异。Zhang 等[54]研究发现外侧盘状半月板复合撕裂所引起的关节软骨损伤较正常外侧半月板复合撕裂更为严重, 远期预后也更差一点。Cho 等[55]研究结果显示, 在外侧盘状半月板撕裂中, 单纯水平撕裂所造成的关节软骨损伤程度较其他类型轻, 这可能是由于水平撕裂未破坏盘状半月板的环状纤维结构, 对关节软骨的生物力学影响较小。不同手术方式的选择, 也会对膝关节的功能及远期预后产生影响, 大多数研究证实 DLM 患者行半月板全切或次全切手术与膝关节退行性改变有明显的相关性。半月板手术的术后评估有很多种, 但是大部分医生对 Lysholm 评分和 Ikeuchi 评分具有较高的认可度, 因此, Lysholm 评分和 Ikeuchi 评分普遍适用于半月板损伤患者的术前和术后评估。同样是进行关节镜下半月板成形术, 患者的术后评分也会存在差异, 患者的年龄和软组织损伤情况则被认定为差异所在, 软骨损伤严重以及年龄较大的患者中, 盘状半月板的患者较非盘状半月板的疗效差[56]。针对于盘状半月板的术后分析, 术后疼痛是一个不可忽略的因素, 而其中高龄、关节软骨损伤、术前负重时间  $\geq 1$  周被认为为独立危险因素[57]。

## 6. 小结

目前的研究显示, 盘状半月板即为形态结构异常的半月板, 不能很好地起到缓冲关节受力、促进关节活动的作用, 大多数学者的临床研究及基础研究更多地关注于盘状半月板的显微结构及发病机制。针对于盘状半月板手术方式的选择, 则需要外科医生权衡利弊。针对盘状半月板生物力学研究还需要进行深入探讨, 从而使盘状半月板的诊治更加的规范。

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