

# 髌下脂肪垫与膝关节骨性关节炎的关系

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## 摘要

膝关节骨性关节炎(knee osteoarthritis, KOA)是严重影响中老年人独立生活能力、生活质量以及致残的主要疾病之一, 膝骨关节炎是一种累及全膝关节的复杂的炎症性退行性关节疾病, 典型的病理特征为软骨局灶变性损伤、滑膜内膜炎症、边缘骨赘增生、骨膨大和软骨下骨肥厚反应, 会引起膝关节酸痛、肿胀、僵硬, 伴有日常活动受限, 晚期情况下还会出现内外翻、挛缩畸形, 最终导致残疾。髌下脂肪垫位于膝关节囊内、化膜外, 内含丰富的血管及神经组织, 还可分泌炎症因子, 与膝关节骨性关节炎的发生、发展有着紧密的联系, 故而, 解释了髌下脂肪垫的损伤会引起膝关节的明显疼痛。现今, 临床医生对半月板及韧带损伤引起的膝关节疼痛较为重视, 常常会忽略对髌下脂肪垫的损伤的诊断。本文旨在对髌下脂肪垫与膝关节骨性关节炎的关系进行阐述, 以期对临床治疗膝关节骨性关节炎提供一定的参考意义。

## 关键词

膝关节骨性关节炎, 髌下脂肪垫, 炎症因子

# The Relationship between the Infrapatellar Fat Pad and Knee Osteoarthritis

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## Abstract

Knee osteoarthritis (KOA) is one of the major diseases that seriously affect the ability to live independently, quality of life, and disability in middle-aged and elderly people. Knee osteoarthritis is a complex inflammatory degenerative joint disease that involves the whole knee joint, and the typical pathological features are focal degenerative damage to the cartilage, synovial endothelial inflammation, marginal osteophyte hyperplasia, bone enlargement and subchondral bone hyper-

trophic reaction, which can cause knee joint pain, swelling, stiffness, accompanied by limitation of daily activities, and in advanced cases, internal and external rotation, contracture deformity, and ultimately lead to disability. The infrapatellar fat pad is located inside the knee joint capsule and outside the chemosis, which contains rich blood vessels and nerve tissue, and also secretes inflammatory factors, which is closely related to the occurrence and development of osteoarthritis of the knee joint, thus, explaining that damage to the infrapatellar fat pad can cause significant pain in the knee joint. Nowadays, clinicians pay more attention to knee pain caused by meniscus and ligament injuries, and often neglect the diagnosis of infrapatellar fat injury. The purpose of this paper is to elaborate on the relationship between infrapatellar fat pad and knee osteoarthritis, with a view to providing some reference significance for clinical treatment of osteoarthritis of the knee.

## Keywords

Knee Osteoarthritis, Infrapatellar Fat Pad, Inflammatory Factors

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## 1. 膝关节骨性关节炎

现今,随着人口肥胖率的上升和老龄化,膝关节骨性关节炎(knee osteoarthritis, KOA)的患者逐渐成为家庭社会的重要负担,膝关节的疼痛,伴随着关节内外翻畸形或屈曲挛缩畸形进行性加重,膝关节功能的丧失,严重影响患者的工作和生活。膝关节是一种累及全膝关节的复杂的炎症性退行性关节疾病,典型的病理特征为软骨局灶变性损伤、滑膜内炎症、边缘骨赘增生、骨膨大和软骨下骨肥厚反应,会引起膝关节酸痛、肿胀、僵硬,伴有日常活动受限,晚期情况下还会出现内外翻、挛缩畸形,最终导致残疾[1]。目前膝关节骨性关节炎未能发现能够逆转其疾病进展的药物,现在的治疗主要是缓解疼痛症状及延缓疾病进展,其治疗措施主要为口服止痛药物、关节腔内注射玻璃酸钠及行关节置换术、截骨术等[2]。目前较多学者通过病患临床表现的严重程度结合膝关节 X 线进行膝关节的分期,田雪秋等人[3]通过临床表现结合 K&L 分级将疾病分为 3 期,早期:表现为膝关节轻度疼痛,膝关节活动度尚可, K&L 分级为 0~I 级;中期:表现为膝关节疼痛较前明显加重,休息后疼痛稍缓解,膝关节存在关节不稳的情况, K&L 分级为 II~III 级;晚期:表现为膝关节疼痛加剧,严重影响生活,膝关节活动度明显受限 K&L 分级为 IV 级。

### 膝关节骨性关节炎的发病机制

虽然患有膝关节骨性关节炎的患者逐年增多,但是其发病机制仍然不清[4]。在过去膝关节骨性关节炎曾被认为是一种单纯的机械性软骨退化疾病[5]。最近关于膝关节骨性关节炎的概念认为它是一种以关节整体发生病理改变的疾病,所有关节内和周围组织(软骨下骨、滑膜、韧带、半月板和髌下脂肪垫)都有可能参与膝关节骨性关节炎的发病[6]。生物力学的改变、遗传因素、炎症、激素等都是膝关节骨性关节炎的发病因素。其中遗传因素对骨性关节炎发病的影响被认为在 39%到 65%之间,某些基因与骨赘生成和关节间隙狭窄的发生有关,并且能影响细胞外软骨基质和软骨信号分子[7]。炎症介质,如白介素-1 (IL-1)、肿瘤坏死因子- $\alpha$  (TNF- $\alpha$ ),由滑膜、软骨、骨等周围关节组织释放,可诱导基质金属蛋白酶(MMPS)、

聚糖酶等分解代谢基因，可引起细胞外软骨基质重塑[8]。体脂组织已被证明与膝骨性关节炎的发生和发展有关，全身和局部脂肪通过生物力学、代谢、炎症因子和脂肪纤维化在膝关节骨性关节炎中发挥作用[9]。

## 2. 髌下脂肪垫的解剖特点

髌下脂肪垫是填充于髌骨下极、髌骨肌腱后方、胫骨结节上方，位于滑膜内外的一种以弹性纤维脂肪组织团块[10]。

髌下脂肪垫有着丰富的血液网络，其丰富的血管网面在髌韧带的后方、脂肪垫上方形成，主要由腠动脉分支形成的关节动脉网络，即血管吻合网，并且，可以区分高灌注的外周区和中心血管化较差的区域[11]。

髌下脂肪垫也有着丰富的神经分布，GARDNER 等人[12]针对膝关节神经支配的研究详细描述了 IPFP 的神经分布，IPFP 的前内侧部分由隐神经、胫神经、闭孔神经的分支和股内侧神经支配，而前外侧部分由股外侧神经的分支以及胫神经、腓返神经和腓总神经支配。

## 3. 髌下脂肪垫与膝关节骨性关节炎的关系

髌下脂肪垫在膝关节骨性关节炎的发生、发展中具有双重作用。髌下脂肪垫丰富的血管网络系统不仅仅可以营养自身，还可以为其周围组织结构提供血供[13]。髌下脂肪垫可以通过调节关节液在膝关节的分布起到润滑功能，此外也能提供缓冲减震作用维持膝关节的稳定，从而减少膝关节的运动损伤[9]。髌下脂肪垫在膝关节活动过程中有着重要的作用，当膝关节屈曲时，髌下脂肪垫本身收缩变硬，填充于膝关节的腔隙之间，有效的限制了膝关节过度内翻、过伸等活动，减少关节内刺激及摩擦，并且可以缓冲部分压力，起到衬垫作用[14]。Cai 等[15]通过对 174 例膝关节骨性关节炎患者的髌下脂肪垫、关节软骨、软骨缺损及骨髓损伤体积的 MRI 测量结果进行分析，结果显示髌下脂肪垫体积越大，软骨体积越大，软骨缺损越小，骨髓损伤和硬化骨发生越少，提示髌下脂肪垫对膝关节骨性关节炎具有保护作用。在另一方面，髌下脂肪垫由脂肪细胞、免疫细胞和血管构成，能够产生许多的炎性介质(如细胞因子、白介素类和脂肪因子)，这些炎性介质能促进软骨和半月板的老化，导致膝关节的炎症、纤维化和疼痛[16]。有研究发现髌下脂肪垫分泌的肽降钙素基因相关肽(vasodilatory neuropeptide calcitonin gene-related peptide, CGRP)，远高于其他滑膜组织，其通过环氧化酶-2(COX-2)调节转录发挥作用，从而导致膝关节骨性关节炎的发病和进展[17]。杨放[18]等人对患有膝关节骨性关节炎的 30 名患者进行研究发现，髌下脂肪垫分泌的白细胞介素-6、白细胞介素-8 和肿瘤坏死因子- $\alpha$  在膝关节骨性关节炎的患者中水平明显升高，并可能通过各种途径，直接或间接作用于膝关节及膝关节滑膜、膝关节软骨，最终加重膝骨关节炎疾病的进展。在膝关节骨性关节炎中髌下脂肪垫脂联素的表达与瘦素水平呈正相关，瘦素被发现可增加胰岛素样生长因子-1(insulin-like growth factor-1, IGF-1)、转化生长因子- $\beta$ (transforming growth factor- $\beta$ , TGF- $\beta$ )，这些因子与软骨加速分解有关，脂联素可能在髌下脂肪垫组织中具有促炎作用，诱导软骨细胞系中炎症标志物的表达[19][20]。髌下脂肪垫中含有的多肽性 C 和蛋白阳性神经纤维，被认为在炎症反应中扮演着重要角色，因而可能导致膝前疼痛的发生[21]。

## 4. 小结与展望

膝关节是人体当中最大且是最复杂的关节，而髌下脂肪垫是膝关节中重要的组成成分，髌下脂肪垫在膝关节骨性关节炎中扮演着双重角色，一方面在生理状态和膝关节骨性关节炎早期阶段其具有缓冲震荡、稳定润滑、提供血供等保护膝关节作用；另一方面随着膝关节骨性关节炎的发病进展，髌下脂肪垫

可通过瘦素、内脂素等脂肪因子、炎症介质在膝关节骨性关节炎进展中起到破坏性作用，孰重孰轻还有待进一步研究明确。所以，应当重视髌下脂肪垫的存在，明确髌下脂肪垫的具体作用，在膝关节骨性关节炎的治疗中重视髌下脂肪垫。

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