

# 肌骨超声(MSUS)在幼年特发性关节炎(JIA)中的应用

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## 摘要

肌肉骨骼超声(Musculoskeletal ultrasound, MSUS)在幼年特发性关节炎(Juvenile idiopathic arthritis, JIA)中的应用及作用越来越得到证实。大量研究表明, MSUS在检测亚临床滑膜炎方面比临床检查更敏感。在儿童关节炎的管理中, MSUA作为一种行之有效的检查手段, 无需镇静且无辐射, 被患者及家属广泛接受。MSUS可以更好地表征炎症受累部位和程度, 有助于改善幼年特发性关节炎亚型的分类。此外, 它能够增加关节内注射的有效性及安全性。最后, 在随访期间, 在检测亚临床疾病活动时, MSUS有助于治疗决策。本综述描述了MSUS在儿童中应用的优势和不足与其在JIA患者诊断、治疗、随访中的作用。

## 关键词

幼年特发性关节炎, 儿童, 肌骨超声

# The Application of Musculoskeletal Ultrasound (MSUS) in Juvenile Idiopathic Arthritis (JIA)

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## Abstract

The application and role of Musculoskeletal ultrasound (MSUS) in Juvenile idiopathic arthritis (JIA) have been increasingly confirmed. Numerous studies have shown that MSUS is more sensitive in detecting subclinical synovitis than clinical examination. In the management of pediatric arthritis, MSUA is an effective means of examination without sedation and radiation, and is widely accepted by patients and their families. MSUS can better characterize the site and extent of inflammation and help to improve the classification of juvenile idiopathic arthritis subtypes. In addition, it can increase the effectiveness and safety of intra-articular injections. Finally, during follow-up, MSUS facilitates treatment decisions when detecting subclinical disease activity. This review describes the advantages and disadvantages of MSUS in children and its role in the diagnosis, treatment, and follow-up of JIA patients.

## Keywords

Juvenile Idiopathic Arthritis, Children, Musculoskeletal Ultrasound

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## 1. 引言

幼年特发性关节炎(JIA)是儿童时期常见的慢性风湿性疾病,是一组以滑膜慢性炎症为主要特征的异质性关节炎。是导致儿童后天性残疾的主要原因,因此,早期诊断并予以及时的治疗对远期预后至关重要,诊断时间越晚,长期不良结局的风险越高[1]。

近年来,肌肉骨骼超声(MSUS)在幼年特发性关节炎(JIA)中的应用越来越广泛,与X线与MRI影像学方法相比,MSUS是一种经济、易于操作且无辐射、被患者及家属广泛接受的检查工具。大量研究表明,MSUS在幼年特发性关节炎患者的诊断、评估、治疗中有着极大的价值。在JIA的诊断中,MSUS可以更好地反应受累关节,有助于明确JIA不同亚型的分类。在治疗方面,MSUS可以引导关节内及肌腱周围注射,从而保证操作的准确性及提高疗效。在随访方面,MSUS可以检测JIA患儿疾病活动,进而协助及时调整治疗。本综述重点描述了MSUS在JIA患者诊断、治疗、随访中的作用。

## 2. 儿童 MSUS 的优势

近年来,影像学检查被广泛应用于幼年特发性关节炎的诊断及随访中。在JIA关节病变的评估中,X线的作用较局限,无法直接观察软骨和软组织炎症且难以发现早期病变,只能检测到关节间隙变窄和骨侵蚀等晚期表现[2][3],不利于早期诊断。MRI是评估儿童肌肉骨骼病变的一种有效检测手段,也是幼年特发性关节炎评估中最有效的影像学手段[4],检测弥补了X线的缺点,在观察软组织炎症和早期病变方面具有较强的敏感性[5],但MRI具有费用高、检查时间长、造影剂过敏及可能需要麻醉等局限性。近年来,MSUS在成人类风湿关节炎的诊断、治疗及预后评估中的作用得到了很好的验证,因此,肌骨超声在儿童关节炎中的应用越来越广泛,与体格检查相比,肌骨超声能更早地发现关节病变,与其他成像技术相比,MSUS肌骨超声让患者免于电离辐射暴露的风险,且不需要镇静或全身麻醉,另外,它允许在同一次检查中进行多个关节和对同一个关节进行多个平面的评估,并对有症状和无症状的关节进行

比较、动态研究[6]。因此,在关节炎患儿的动态随访中,患儿及其父母的接受度高。

### 3. 儿童 MSUS 的不足

尽管 MSUS 在儿童关节炎中的效用越来越被强调,且被广泛接受,但由于 MSUS 是一项高度依赖操作者的技术,需要对操作者进行长期及特定的培训,而不是所有地区都有相关的培训,这对 MSUS 的推广带来了极大的挑战。此外,MSUS 检查时视野有限,无法观察整个关节空间,且在骶髂关节、颌关节等中轴关节中的价值有限。

值得注意的是,与成人相比,儿童具有的特有的骨骼生长特性,包括与年龄相关的关节软骨厚度变化、生理性软骨血管化以及骨化中心和生长板的存在。由于这些独有的特征,一些陷阱可能导致在小儿关节方面经验不足的超声医师对图像进行令人尴尬的误解。因此,对高比例软骨/骨骼的认识,儿童成长过程中的变化,以及关节血管的解剖学知识是最重要的。

## 4. MSUS 在幼年特发性关节炎中的应用

### 4.1. 诊断

根据现行国际风湿病协会联盟(International League of Associations for Rheumatology, ILAR)标准[7],根据受累的关节数量、是否有关节外症状及生物标志物(抗核抗体、类风湿因子和 HLA-B27)受累等因素,将幼年特发性关节炎分为了 7 种亚型,包括:全身型关节炎、类风湿因子(RF)阳性多关节型关节炎、类风湿因子(RF)阴性多关节型关节炎、少关节型关节炎、附着点相关性关节炎、银屑病性关节炎、未分类关节炎。

幼年特发性关节炎的诊断主要基于临床特征,并排除其他类似慢性关节炎性疾病,超声在缩小鉴别诊断范围方面具有潜在作用[8]。在一项 31 名疑似幼年特发性关节炎患者的研究中,对纳入研究的患儿进行关节超声检查后,有 9 例被确诊为幼年特发性关节炎,9 例被归为健康儿童,13 例被诊断为其他疾病[9]。在幼年特发性关节炎疾病早期阶段,仅使用体格检查可能会遗漏一些难以发现的关节炎,可能导致错误分类,进而延误治疗。超声在识别亚临床关节滑膜炎方面的较临床检测敏感性高已在多个研究中得到证明[10] [11] [12],这可能导致了儿童关节炎的重新分类。在 Haslam 的研究队列中,在 6/17 名 JIA 患儿中发现了亚临床滑膜炎,17 名少关节幼年特发性关节炎患者中有 1 名在超声检查后重新归类为多关节型[13]。另外,在检查困难且疼痛表现欠佳的幼儿中和重度关节疼痛的患者中,MSUS 也是重要诊断工具。

MSUS 不仅在检测幼年特发性关节炎受累关节数目上有较大的优势,在正确识别炎症的确切位置以及区分滑膜炎、腱鞘炎或附着点炎方面同样较临床检测优势,尤其是在踝关节受累的幼儿中较为突出[14] [15] [16],Charlotte Boroccode 等人发现在手腕可踝关节检查中约 44%的临床检查阳性,MSUS 检查后发现其并未真正累及腕关节及踝关节[17]。

附着点炎是指韧带、肌腱和关节囊附着在骨骼上的炎症,主要涉及幼年特发性关节炎的附着点相关性关节炎(ERA)亚型。临床上,儿童附着点炎主要通过临床表现进行诊断,包括局部疼痛、压痛和肿胀。在附着点相关性关节炎的早期研究表明,与临床检查相比,MSUS 附着点炎的检测更敏感、更特异[18] [19]。需注意的,目前仍缺乏对儿童附着点炎的共识定义,因此,目前仍延用在成人中验证的定义。

最后,超声作为一种辅助手段,可用于幼年特发性关节炎的鉴别诊断,有助于提高幼年特发性关节炎分型诊断的准确性。

### 4.2. 治疗

关节内皮质类固醇注射(intra-articular corticosteroid injection, IACI)是幼年特发性关节炎中基本且经

过验证的治疗方法, 一直以来, ICIA 仅通过触诊肿胀的关节和解剖标志确定注射位置。然而错位 IACI 不仅影响治疗效果, 还可能导致永久性损伤, 如坏死和组织萎缩, 因此, 提高 IACI 的准确度对提高其有效性及安全性至关重要。使用超声引导针头可通过促进目标区域的可视化来提高准确性、性能和安全性, 避免对神经、血管、肌腱、韧带和软骨等脆弱组织造成损害。多项研究表明超声可协助关节内注射的准确放置[20] [21] [22]。另外, MSUS 的精确度允许将皮质类固醇注射到肌腱周围, 从而避免了因错误的直接肌腱注射而导致的肌腱断裂。值得注意的是, 这些注射操作需经专业的超声培训过医师进行。

### 4.3. 随访

幼年特发性关节炎是一种慢性关节炎, 需长期随访疾病活动度, 进一步指导治疗。超声对亚临床滑膜炎的检出较临床检测更敏感, 然而, 发现亚临床滑膜炎需扩展关节检查, 需要花费更长的时间, 因此, 这在幼儿中可能很难实现。目前, 多项研究旨在开发一种 MSUS 关节特异性评分系统, 确定识别活动性疾病所需最小关节数。使扩展关节检查更可行, 最大限度的识别亚临床关节炎。在一项在幼年特发性关节炎中测试简化联合功率多普勒超声 PDUS 评估与综合评估的纵向研究研究中, 结果表明 10 关节(双侧膝关节、踝关节、腕关节、肘关节和第二 MCP 关节) PDUS 评估, 对变化的敏感性优于综合评估[23]。在另外一项研究中开发并证实儿童关节炎局限性肌肉骨骼超声检查(MUSICAL)方案, 并证实基于 10 个关节(双侧膝关节、腕关节、MCP2、MCP3 以及踝关节)的有限 MSUS 检查可捕获所有活动性滑膜炎患者[24]。

大量的证据表明, 及时治疗幼年特发性关节炎与更好的结局相关[25]。在 Vega-Fernandez P 等人的研究中, 从基线到随访, MSUS 滑膜炎发生率在统计学上显著下降, 表明它是一种对治疗干预有反应的敏感测量[26]。另外, 在 JIA 患者的随访中, 发现超声异常是个体患者复发的有力预测指标, 超声 PD 信号阳性的亚临床滑膜炎患者在药物治疗后缓解, 但发作风险较高[27]。在另外一项研究中发现基线超声评分较高的患者在 6 个月时复发风险较高[28]。无论采用何种治疗, 超声阳性患者与超声阴性患者发生耀斑的风险几乎高出四倍[29]。然而, Nieto Gonzalez 等人研究中的一项 MSUS 检测到的亚临床滑膜炎被证明不是发作的预测因子[30]。

MSUS 在评估新发幼年特发性关节炎患儿滑膜炎方面表现出高敏感性, 在同一项前瞻性研究中, 结果显示超过一半的临床缓解的病例存在 MSUS 活性[31]。这表明临床缓解并不等于“超声缓解”。MSUS 可能被纳入幼年特发性关节炎的治疗靶向方法, 特别是将 MSUS 缓解作为新的治疗靶点[32]。事实上, 如果 MSUS 在引入治疗 3 个月后仍显示疾病活动度, 则可以考虑改变治疗以获得更好的长期结局[33], 因此, 以超声缓解未治疗目标可能改善长期结果。

## 5. 结论

作为一种经济、快速、无创的成像工具, MSUS 在 JIA 患者诊断、治疗、随访中的作用日益增长。但为了避免误诊, 需了解儿童关节超声特点。另外, MSUS 虽在早期关节损害评估方面具有较强的敏感性, 但在远期预后及长期结局的预测价值方面的研究还待进一步加强。

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