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论著

股骨髁间窝形态、髁间窝宽度指数与前交叉韧带损伤间关系的相关性研究

王海蛟^{1,2}, 黄竞敏^{1,2}, 吴疆², 赵斌², 李冬超^{1,2}, 李昱鸿^{1,2}

(1.天津中医药大学研究生院, 天津 300193; 2.天津市天津医院运动损伤与关节镜科, 天津 300211)

摘要 目的:应用关节镜与磁共振检查,明确股骨髁间窝形态、髁间窝宽度指数(NWI)与前交叉韧带(ACL)损伤间关系的相关性。方法:选取60例行磁共振检查与关节镜手术的患者,其中ACL损伤患者30例,男性23例,女性7例,年龄(28.36±8.30)岁,左膝16例,右膝14例;非ACL损伤患者30例,男性19例,女性11例,年龄(32.69±7.53)岁,左膝13例,右膝17例。观察并记录其股骨髁间窝形态,测量股骨双髁间宽度、髁间窝宽度,并应用公式计算出NWI。结果:(1)股骨髁间窝形态与ACL损伤间的关系:在30例ACL损伤的患者中,63.3%(19例)的患者髁间窝形态为“A”形,36.7%(11例)为“U”形,0.0%(0例)为“W”形,三者之间差异明显,具有显著统计学意义($P<0.05$)。(2)髁间窝形态与NWI间的关系:髁间窝形态为“A”形的患者中有34.6%(9例)的患者NWI非正常,髁间窝形态为“U”形的患者中有30.3%(10例)的患者NWI非正常,两者相比,差异不明显,无显著统计学意义($P>0.05$)。(3)NWI与ACL损伤间的关系:在30例ACL损伤的患者中仅有20.0%(6例)的患者NWI非正常,而80.0%(24例)的患者NWI均正常,表明两者之间相关性较低,不具有显著统计学意义($P>0.05$)。结论:髁间窝形态的不同与ACL损伤之间存在显著相关性,“A”形髁间窝的出现是导致ACL损伤的一个重要危险因素,而较低的NWI不是导致ACL损伤的一个重要危险因素。

关键词 股骨髁间窝形态;髁间窝宽度;髁间窝宽度指数;前交叉韧带损伤;关节镜;磁共振

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Relationship between the femoral condyle notch shape, notch intercondylar width and anterior cruciate ligament injury

WANG Hai-jiao^{1,2}, HUANG Jing-min^{1,2}, WU Jiang², ZHAO Bin², LI Dong-chao^{1,2}, LI Yu-hong^{1,2}

(1. Graduate School, Tianjin University of Traditional Chinese Medicine, Tianjin 300193, China; 2. Department of Sports Injuries and Arthroscopy, Tianjin Hospital, Tianjin 300211, China)

Abstract Objective: To explore the relationship between the femoral condyle notch shape, the intercondylar notch width index (NWI) and anterior cruciate ligament (ACL) injuries by MRI and arthroscopy. **Methods:** A total of 60 patients were enrolled in the study, including 30 patients with ACL injury, 23 males and 7 females, aged (28.36 ± 8.30) years, 16 cases of left knee, 14 cases of right knee; non-ACL injury 30 patients, 19 males and 11 females, aged (32.69 ± 7.53) years, 13 cases of left knee, 17 cases of right knee, all patients were examined by arthroscopy and MRI diagnosis. The femoral condyles notch shape types was observed and recorded, the width of the femoral condyles and intercondylar notch width were measured for calculating the NWI. **Results:** (1) Relationship between femoral notch shape and anterior cruciate ligament tear: In 30 patients with ACL injuries in 63.3% (19 cases) of patients intercondylar notch shape “A” type, 36.7% (11 cases) for the “U” type, 0.0 (0 cases) as “W” type, differences between the three, with a statistical significance, were found ($P<0.05$). (2) Relationship between femoral notch shape and NWI: intercondylar notch shape of “A” type patient in 34.6% ($n=9$) of patients NWI were abnormal and intercondylar notch shape of “U” type patient in 30.3% ($n=10$) of patients NWI were abnormal, no statistical significance was found ($P>0.05$). (3) Relationship between femoral NWI and anterior cruciate ligament tear: Only in 30 patients with ACL injuries in 20.0% ($n=6$) of patients NWI were abnormal, whereas 80.0% (24 cases) of patients NWI were normal, indicating a low correlation between the two, not statistically significant ($P>0.05$). **Conclusion:** The Type “A” femoral notch could be a risk factor for ACL injury, while lower NWI may not be a significant risk factor for ACL injury.

Key words femoral intercondylar notch shape; intercondylar notch width; intercondylar notch width index; anterior cruciate ligament injury; arthroscopy; MRI

前交叉韧带(anterior cruciate ligament, ACL)是维持膝关节稳定的重要解剖结构,能够限制胫骨过度前移和轴向移动,同时因其走行特点对膝关节的

内翻具有一定的限制作用。ACL损伤后可导致膝关节不稳和(或)并发关节内其他部位的损伤(如软骨、半月板等)。ACL损伤常由外伤所致,近年来随着研究的不断深入,人们发现股骨髁间窝的一些解剖学形态参数(如髁间窝形态、髁间窝宽度指数

作者简介 王海蛟(1989-),男,硕士在读,研究方向:中医骨伤科学;
通信作者:黄竞敏, E-mail: huangjingmin@126.com。

(notch width index, NWI)等与 ACL 损伤密切相关^[1-2],但目前这一观点还存很多争议^[3-4]。本研究拟通过应用关节镜与磁共振检查,明确股骨髁间窝形态、NWI 与 ACL 损伤间的关系。

1 资料与方法

1.1 一般资料

1.1.1 选择标准 纳入标准:(1)18岁≤年龄≤45岁,病程小于6个月的患者;(2)经关节镜与磁共振(MRI)检查确诊存在 ACL 损伤或关节内其他部位损伤;(3)双下肢负重位 X 线片显示无明显膝关节内外翻畸形;(4)0°≤胫骨平台后倾角≤8°;(5)膝关节 X 线检查经 Kellgren-Lawrence 评分≤1级;(6)除 ACL 损伤外,不合并膝关节其他部位韧带损伤或全身其他部位损伤;(7)患者术前的 X 线及 MRI 资料完整。排除标准:(1)18岁>年龄>45岁,病程大于6个月的患者;(2)经关节镜与磁共振检查,发现髁间窝与股骨髁形态不完整的患者;(3)双下肢负重位 X 线片显示存在明显膝关节内外翻畸形;(4)胫骨平台后倾角>8°;(5)膝关节 X 线检查经 Kellgren-Lawrence 评分>1级;(6)除 ACL 损伤外,合并有膝关节其他部位韧带损伤或全身其他部位损伤的患者;(7)既往有膝关节结核、化脓性关节炎、风湿或类风湿性关节炎等膝关节疾病病史的患者;(8)既往有患膝关节外伤或相关手术史的患者;(9)患者术前的 X 线及 MRI 资料不完整。

1.1.2 研究对象 选取 2014 年 3 月-2015 年 6 月

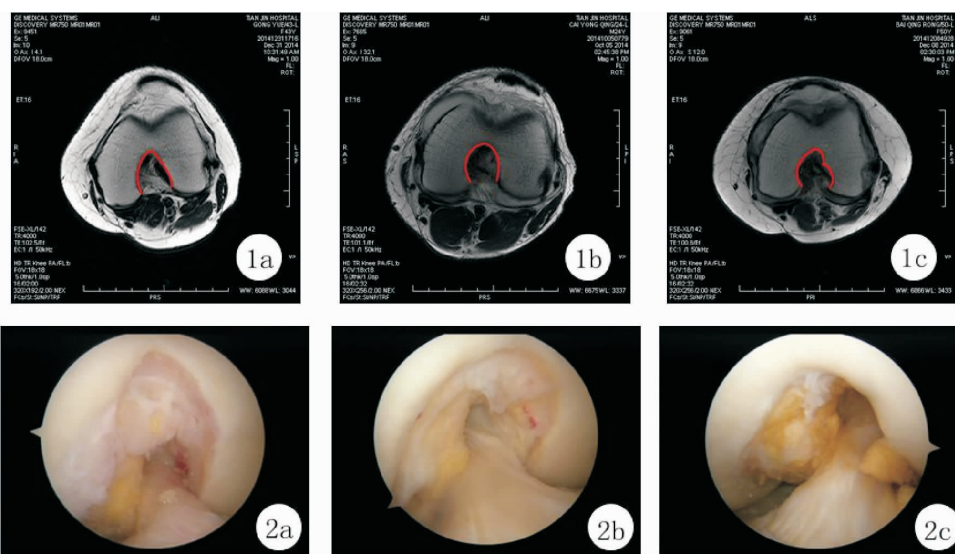
天津市天津医院收治的患者 60 名,其中 ACL 损伤患者 30 名,年龄 18~43 岁,平均 28.36 岁,男性 23 例,女性 7 例,左膝 16 例,右膝 14 例;非 ACL 损伤患者 30 名,年龄 22~48 岁,平均 32.69 岁,男性 19 例,女性 11 例,左膝 13 例,右膝 17 例。所有患者均经关节镜与磁共振检查确诊。

1.2 方法

1.2.1 磁共振评价 采用美国 GE Discovery MR750 3.0T 超导型全身磁共振扫描仪,患者呈仰卧位,膝关节在非负重状态下自然伸直,行膝关节矢状位、冠状位、轴位扫描。在膝关节轴位图像上,选取由近端至远端,股骨内、外侧髁保持连续性,且在股骨外侧髁能够观察到腓肌腱沟的层面作为观察髁间窝形态的标准层面^[5]。股骨双髁间宽度、髁间窝宽度的测量也在该层面进行。磁共振图像的评价由同一名经验丰富的放射科医生完成。

1.2.2 关节镜检查 由同一名经验丰富的运动医学医生对所有 60 例患者进行膝关节镜检查与操作。采用连续硬膜外麻醉,麻醉满意后,取膝关节镜标准髌前内(AM)、外(AL)侧入口,置入关节镜,必要时取其他辅助切口以完成镜下操作。术中观察髁间窝形态,探查 ACL 的张力及完整性并作记录。若发现 ACL 断裂,则行 ACL 重建术,如合并半月板撕裂则一期行半月板修复或成形处理。术后给予常规护理。

1.2.3 髁间窝形态的确定 髁间窝形态的确定采用 van Eck 等^[5]描述的方法来确定,见图 1。

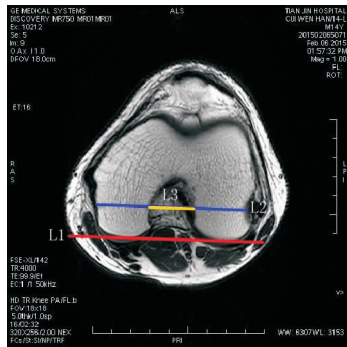


1a.“A”形髁间窝,如红色实线所示,髁间窝形状为从出口部向顶端宽度逐渐减小,顶端略显尖锐,且仅有一个顶端,类似于大写英文字母“A”;1b.“U”形髁间窝,如红色实线所示,髁间窝形状为从出口部向顶端宽度无明显减小,顶端较为圆润,类似于倒置的大写英文字母“U”;1c.“W”形髁间窝,如红色实线所示,其形状与“U”形髁间窝类似,区别在于其有两个顶端,类似于倒置的大写英文字母“W”。关节镜下所见与核磁共振图像所见相似:2a.“A”形髁间窝;2b.“U”形髁间窝;2c.“W”形髁间窝

图1 核磁共振轴位图像

Fig 1 magnetic resonance (MR) axial T2WI images

1.2.4 髁间窝宽度的测量方法 髁间窝宽度的测量方法采用 Souryal 等^[6]描述的方法来测量,见图 2。NWI 计算公式如下: $NWI= \text{髁间窝宽度}(L3)/\text{股骨双髁间宽度}(L2)$ 。NWI>0.27 则认为髁间窝宽度正常,反之 NWI≤0.27 则认为髁间窝宽度狭窄^[7]。



在轴位核磁共振图像上,画一条直线连接股骨内、外侧髁最低点 L1 (如红色实线所示),以此线作为关节面水平线,将 L1 向上平移至腓肌腱沟最低点水平(如蓝色实线所示),此线称为 L2。L2 与髁间窝两侧壁交点间线段 L3(如黄色实线所示)的长度为髁间窝宽度,与股骨内外侧髁外侧壁交点间线段的长度为股骨双髁间宽度

图 2 髁间窝宽度的测量方法

Fig 2 Condylar notch width measuring method in the axial magnetic resonance images

1.3 统计学分析 采用 SPSS 18.0 统计学软件对数据进行统计学分析,计数资料用百分数(%)表示,采用 χ^2 检验进行数据间的比较, $P<0.05$ 被认为差异具有统计学意义。

2 结果

2.1 髁间窝形态与 ACL 损伤间的关系 在 30 例 ACL 损伤的患者中,63.3%(19 例)的患者髁间窝形态为“A”形,36.7%(11 例)为“U”形,两者之间差异明显,具有显著统计学意义($P<0.05$)。“W”形例数较少,未进行统计学比较。见表 1。

表 1 髁间窝形态与 ACL 损伤间的关系

Tab 1 Relationship between femoral notch shape and ACL tear

| 髁间窝形态 | 例数 | ACL | |
|-------|----|-----|-----|
| | | 损伤 | 未损伤 |
| A | 26 | 19* | 7 |
| U | 33 | 11 | 22 |
| W | 1 | 0 | 1 |

与“U”形比较: * $P<0.05$

2.2 髁间窝形态与 NWI 间的关系 髁间窝形态为“A”形的患者中有 34.6%(9 例)的患者 NWI 非正常,髁间窝形态为“U”形的患者中有 30.3%(10 例)的患者 NWI 非正常,两者相比,差异不明显,无显著统计学意义($P>0.05$)。“W”形例数较少,未进行统计学比较。见表 2。

表 2 髁间窝形态与 NWI 间的关系

Tab 2 Relationship between femoral notch shape and NWI

| 髁间窝形态 | 例数 | NWI | |
|-------|----|-----|----------------|
| | | 正常 | 非正常 |
| A | 26 | 17 | 9 [#] |
| U | 33 | 23 | 10 |
| W | 1 | 1 | 0 |

与“U”形比较: [#] $P>0.05$

2.3 NWI 与 ACL 损伤间的关系 在 30 例 ACL 损伤的患者中仅有 20.0%(6 例)的患者 NWI 非正常,而 80.0%(24 例)的患者 NWI 均正常,表明 ACL 损伤与非正常 NWI 之间相关性较低,不具有显著统计学意义($P>0.05$)。具体详见表 3。

表 3 NWI 与 ACL 损伤间的关系

Tab 3 Relationship between femoral NWI and ACL tear

| NWI | 例数 | ACL | |
|-----|----|-----------------|-----|
| | | 损伤 | 未损伤 |
| 正常 | 41 | 24 [▲] | 17 |
| 非正常 | 19 | 6 | 13 |

与“非正常 NWI”比较: [▲] $P>0.05$

3 讨论

ACL 损伤后膝关节内的生物力学结构出现紊乱,无法维持关节正常的稳定性,导致关节内其他软组织的损伤(如:软骨、半月板等),使膝关节骨性关节炎提早出现,加速其老化退变进程。引起 ACL 损伤的相关危险因素有很多,如髁间窝宽度指数,髁间窝形态,韧带的体积大小,关节松弛情况等。正确认识这些危险因素与 ACL 的关系,对其早期预防与治疗至关重要。

近年来随着研究的不断深入,人们发现髁间窝形态与 ACL 损伤之间存在着密切相关性,很多学者^[8-12]认为髁间窝形态的差异是导致 ACL 损伤的危险因素之一,但是目前缺乏较高证据等级的研究来证实,因此这一观点现在仍存在争议。Ireland 等^[13]认为髁间窝形态存在“A”形或非“A”形两种,但其与 ACL 损伤无关。van Eck 等^[5]通过关节镜下观察发现,髁间窝存在“A”、“U”和“W”3 种形态,他们经过观察和测量发现“A”形髁间窝的尺寸与其他两种相比较小,髁间窝宽度与 NWI 也相对较小,而较小的髁间窝尺寸增加了 ACL 损伤的风险。他们提出在进行 ACL 重建时如遇到“A”形髁间窝,应采用前内侧入口技术,并进行髁间窝成形以扩大其容量,因为这样可以更好地观察和帮助股骨定位点的选择,预防髁间窝撞击的出现。Al-Saeed 等^[14]通过对

560例患者的轴位磁共振影像资料观察发现,髁间窝存在“A”、“U”和“W”3种形态,这与 van Eck 等在关节镜下的观察相一致。他们对这些数据进行分析研究后认为,“A”形髁间窝的出现是导致 ACL 损伤的一个重要危险因素。在本研究中,30 例 ACL 损伤的患者中,63.3% (19 例)的患者髁间窝形态为“A”形,36.7% (11 例)为“U”形,0.0 (0 例)为“W”形,三者之间差异明显,具有显著统计学意义($P<0.05$)。这表明“A”形髁间窝的出现是导致 ACL 损伤的一个重要危险因素,对人们在日常生活和运动中预防 ACL 损伤具有重要参考意义。

髁间窝宽度与 ACL 损伤间的关系人们认识较早,1938 年就有研究发现髁间窝狭窄人群的 ACL 可能更容易损伤^[15]。此后这一问题逐渐引起人们的重视,但其与“髁间窝形态的差异是导致 ACL 损伤的危险因素之一”这一结论一样也存在很多争议^[3,6,16-18]。Souryal 等^[6]认为髁间窝狭窄与 ACL 损伤之间具有相关性,他们通过拍摄髁间窝穿通位 X 线片,测量股骨双髁间宽度、髁间窝宽度,应用公式计算出 NWI,并以此判断髁间窝的狭窄程度。他们认为 NWI 可以排除年龄、性别、身高、体质量等因素的干扰,较为准确反应出髁间窝的狭窄程度,并能够减少误差,使测量结果标准化。Shelbourne 等^[16]认为较小的 NWI 容易导致 ACL 损伤,但不存在性别差异。Görmeli 等^[17]认为与健康对照组相比,较小的 NWI 增加了患者 ACL 损伤的风险。而关于 NWI 标准值的大小问题,不同的学者也给出了不同的结论。Souryal 等^[6]认为 NWI<0.20 就会增加 ACL 损伤的风险;La Prade 等^[11]认为 NWI<0.19;而 Uhorchak 等^[19]认为 NWI<0.18;Domzalski 等^[20]认为 NWI<0.24;最近 Hoteya 等^[7]采用冠状位磁共振图像研究发现,髁间窝狭窄与 ACL 损伤相关,他们给出的 NWI 标准值为 NWI ≤ 0.25 。本研究中,在 30 例 ACL 损伤的患者中仅有 20.0% (6 例)的患者 NWI 非正常,而 80.0% (24 例)的患者 NWI 均为正常,这表明两者之间相关性较低,NWI 并不是导致 ACL 损伤的一个重要危险因素,这一结果与 Lombardo 等^[3]和 Alizadeh 等^[18]研究结果一致。但是我们认为其出现的原因可能与测量方法不同有关。传统的测量方法为在 X 线片上进行测量,而本研究是在轴位磁共振图像上选取固定的层面进行测量。传统的测量方法存在不能重复测量的弊端^[20],如患者在拍摄 X 线片时需要保持特殊的体位,而这一体位的摆放存在多种方法;拍摄的 X 线片的投影和放大比率也不相同^[8]。目前关于 NWI 与 ACL 损伤间关系的研究大多基于传统

测量方法,而采用磁共振的测量较少,基于其的 NWI 标准值人们目前还没有达成共识。另外本研究还存在纳入样本量较少,研究类型为回顾性研究等局限性,所得结论还有待以后进一步深入研究证实。

在本项研究中,我们发现髁间窝形态的不同与 ACL 损伤之间存在显著相关性,“A”形髁间窝的出现是导致 ACL 损伤的一个重要危险因素,而较低的 NWI 不是导致 ACL 损伤的一个重要危险因素。

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