

膝关节面夹角和股胫角对膝骨关节炎患者步态的影响

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摘要 目的:探讨膝关节面夹角和股胫角对膝骨关节炎(knee osteoarthritis, KOA)患者步态的影响。方法:纳入 KOA 患者 72 例,男 34 例、女 38 例,左侧 33 例、右侧 39 例,年龄(62.8 ± 7.2)岁,病程(12.54 ± 6.37)年。拍摄负重位膝关节 X 线片,测量患侧膝关节面夹角和股胫角;并进行步态分析测试,记录步速及患侧步长、步角、支撑期时间、支撑期百分数等步态参数。分别依据膝关节面夹角和股胫角测量结果将患者分组,对各组患者的步态参数进行比较。结果:72 例患者,患侧膝关节面夹角 $0.2^\circ \sim 7.8^\circ$, 中位数 3.1° ($<1.0^\circ$ 13 例, $1.0^\circ \sim 3.5^\circ$ 34 例, $3.6^\circ \sim 8.0^\circ$ 25 例);股胫角 $170^\circ \sim 186^\circ$, 中位数 178° ($170^\circ \sim 176^\circ$ 18 例, $177^\circ \sim 180^\circ$ 31 例, $181^\circ \sim 187^\circ$ 23 例)。不同膝关节面夹角患者的步角、步速、步长比较,组间差异均有统计学意义 [$12.28^\circ \pm 3.43^\circ$, $15.43^\circ \pm 3.83^\circ$, $20.50^\circ \pm 2.72^\circ$, $F=18.571$, $P=0.000$; (70.59 ± 9.88) $\text{cm} \cdot \text{s}^{-1}$, (62.15 ± 11.47) $\text{cm} \cdot \text{s}^{-1}$, (41.10 ± 7.90) $\text{cm} \cdot \text{s}^{-1}$, $F=27.621$, $P=0.000$; (55.71 ± 4.87) cm , (51.94 ± 4.17) cm , (36.78 ± 7.14) cm , $F=40.272$, $P=0.000$]。膝关节面夹角 $<1.0^\circ$ 患者的步角小于膝关节面夹角 $1.0^\circ \sim 3.5^\circ$ 和 $3.6^\circ \sim 8.0^\circ$ 的患者 ($P=0.030$, $P=0.000$), 膝关节面夹角 $1.0^\circ \sim 3.5^\circ$ 患者的步角小于膝关节面夹角 $3.6^\circ \sim 8.0^\circ$ 的患者 ($P=0.001$)。膝关节面夹角 $3.6^\circ \sim 8.0^\circ$ 患者的步速、步长均小于膝关节面夹角 $<1.0^\circ$ 和 $1.0^\circ \sim 3.5^\circ$ 的患者 ($P=0.000$, $P=0.000$; $P=0.000$, $P=0.000$), 膝关节面夹角 $<1.0^\circ$ 患者的步速、步长与膝关节面夹角 $1^\circ \sim 3.5^\circ$ 患者相比,差异均无统计学意义 ($P=0.053$, $P=0.154$)。不同膝关节面夹角患者的步态支撑期时间、支撑期百分数的组间差异均无统计学意义 [(0.79 ± 0.06) s, (0.86 ± 0.71) s, (0.87 ± 0.12) s, $F=0.811$, $P=0.453$; (63.92 ± 6.34) %, (64.74 ± 8.37) %, (66.74 ± 7.31) %, $F=0.421$, $P=0.660$]。不同股胫角患者的步角、步速、步长、支撑期时间、支撑期百分数比较,组间差异均无统计学意义 [$16.42^\circ \pm 4.88^\circ$, $13.93^\circ \pm 3.57^\circ$, $17.04^\circ \pm 5.43^\circ$, $F=1.311$, $P=0.283$; (56.71 ± 15.72) $\text{cm} \cdot \text{s}^{-1}$, (66.24 ± 11.13) $\text{cm} \cdot \text{s}^{-1}$, (55.38 ± 17.72) $\text{cm} \cdot \text{s}^{-1}$, $F=1.983$, $P=0.154$; (48.63 ± 9.92) cm , (53.51 ± 3.92) cm , (44.85 ± 11.54) cm , $F=3.294$, $P=0.051$; (0.90 ± 0.10) s, (0.82 ± 0.08) s, (0.90 ± 0.15) s, $F=1.838$, $P=0.175$; (64.93 ± 1.37) %, (64.54 ± 0.89) %, (65.62 ± 1.64) %, $F=1.851$, $P=0.173$]。结论:KOA 患者患侧膝关节面夹角越大,步角越大、步速越慢、步长越短,步态支撑期时间、支撑期百分数则无明显变化;而股胫角的大小对 KOA 患者步态无明显影响。

关键词 骨关节炎;膝;步态;膝关节面夹角;股胫角

Influence of knee joint surface angle and femorotibial angle on gait of patients with knee osteoarthritis

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ABSTRACT Objective: To explore the influence of knee joint surface angle and femorotibial angle on gait of patients with knee osteoarthritis (KOA). **Methods:** Seventy-two patients with KOA were enrolled in the study and they consisted of 34 males and 38 females. Their ages were 62.8 ± 7.2 years and disease courses were 12.54 ± 6.37 years. The KOA located in left knee for 33 patients and right knee for 39 patients. The X-ray films of affected knee in weight-bearing position were taken, and the knee joint surface angle and femorotibial angle of affected knee were measured on the X-ray films. Moreover, the gait analysis was performed on all patients, and the gait parameters including gait speed, step length, step angle, support phase time and percentage of support phase were measured and recorded. The patients were divided into different groups according to knee joint surface angle and femorotibial angle respectively, and the gait parameters were compared between different groups. **Results:** The knee joint surface angle ranged from 0.2 to 7.8 degrees with a median of 3.1 degrees

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(<1.0 degree(13), $1.0-3.5$ degrees(34), $3.6-8.0$ degrees(25)), and the femorotibial angle ranged from 170 to 186 degrees with a median of 178 degrees($170-176$ degrees(18), $177-180$ degrees(31), $181-187$ degrees(23)). There was statistical difference in step angle, gait speed and step length between patients with different knee joint surface angles (12.28 ± 3.43 , 15.43 ± 3.83 , 20.50 ± 2.72 degrees, $F=18.571$, $P=0.000$; 70.59 ± 9.88 , 62.15 ± 11.47 , 41.10 ± 7.90 cm/s, $F=27.621$, $P=0.000$; 55.71 ± 4.87 , 51.94 ± 4.17 , 36.78 ± 7.14 cm, $F=40.272$, $P=0.000$). The step angles were smaller in patients with knee joint surface angle of <1.0 degree compared to patients with knee joint surface angles of $1.0-3.5$ degrees and $3.6-8.0$ degrees ($P=0.030$, $P=0.000$), and were smaller in patients with knee joint surface angle of $1.0-3.5$ degrees compared to patients with knee joint surface angle of $3.6-8.0$ degrees ($P=0.001$). The gait speed and step length were smaller in patients with knee joint surface angle of $3.6-8.0$ degrees compared to patients with knee joint surface angle of <1.0 degree and $1.0-3.5$ degrees ($P=0.000$, $P=0.000$; $P=0.000$, $P=0.000$), and there was no statistical difference in gait speed and step length between patients with knee joint surface angle of <1.0 degree and patients with knee joint surface angle of $1.0-3.5$ degrees ($P=0.053$, $P=0.154$). There was no statistical difference in gait support phase time and percentage of support phase between patients with different knee joint surface angles (0.79 ± 0.06 , 0.86 ± 0.71 , 0.87 ± 0.12 seconds, $F=0.811$, $P=0.453$; 63.92 ± 6.34 , 64.74 ± 8.37 , $66.74 \pm 7.31\%$, $F=0.421$, $P=0.660$). There was no statistical difference in step angle, gait speed, step length, support phase time and percentage of support phase between patients with different femorotibial angles (16.42 ± 4.88 , 13.93 ± 3.57 , 17.04 ± 5.43 degrees, $F=1.311$, $P=0.283$; 56.71 ± 15.72 , 66.24 ± 11.13 , 55.38 ± 17.72 cm/s, $F=1.983$, $P=0.154$; 48.63 ± 9.92 , 53.51 ± 3.92 , 44.85 ± 11.54 cm, $F=3.294$, $P=0.051$; 0.90 ± 0.10 , 0.82 ± 0.08 , 0.90 ± 0.15 seconds, $F=1.838$, $P=0.175$; 64.93 ± 1.37 , 64.54 ± 0.89 , $65.62 \pm 1.64\%$, $F=1.851$, $P=0.173$). **Conclusion:** For patients with KOA, the larger the knee joint surface angle of affected knee is, the larger the step angle is and the slower the gait speed is and the shorter the step length is, and there are no obvious change in gait support phase time and percentage of support phase; while the femorotibial angle has no obvious effect on gait of patients with KOA.

Keywords osteoarthritis, knee; gait; knee joint surface angle; femorotibial angle

膝骨关节炎(knee osteoarthritis, KOA)是骨科临床常见病、多发病,以膝关节疼痛、僵硬、活动受限为主要表现,甚至可致膝关节畸形,严重影响患者的生活质量^[1]。KOA病变严重程度与下肢生物力线的改变直接相关^[2],膝关节面夹角和股胫角是膝关节重要的生物力学评价指标,与KOA的发生密切相关^[3-4]。步态分析是从生物力学角度对下肢的运动和受力情况进行动态的量化分析,在KOA的诊断及功能评价上具有突出优势,步态参数一定程度上反映了KOA的关节功能与临床症状^[5]。将静态的生物力学评价指标与动态的步态分析相结合,观察膝关节面夹角和股胫角对KOA患者步态的影响,将为KOA的诊断和治疗评价提供更多的量化指标。2015年6月至2016年5月,笔者利用步态分析系统收集72例KOA患者的步态参数,并对不同膝关节面夹角、不同股胫角患者的各项步态参数进行了比较,现报告如下。

1 临床资料

1.1 一般资料 KOA患者72例,均为浙江中医药大学附属第一医院门诊及住院患者。男34例,女38例;年龄(62.8 ± 7.2)岁,病程(12.54 ± 6.37)年。本试验方案经浙江中医药大学附属第一医院医学伦理

委员会审查通过。

1.2 诊断标准 依据2007年中华医学会骨科学分会修订的KOA临床诊断标准^[6]:①近1个月内反复膝关节疼痛;②站立或负重位X线片示关节间隙变窄、软骨下骨硬化和(或)囊性变、关节缘骨赘形成;③关节液(至少2次)清亮、黏稠,白细胞 <2000 个 \cdot mL⁻¹;④年龄 ≥ 40 岁;⑤晨僵 ≤ 30 min;⑥活动时有关节摩擦音(感)。符合①②或①③⑤⑥或①④⑤⑥项即可诊断为KOA。

1.3 纳入标准 ①符合上述诊断标准;②单侧KOA;③未进行过膝关节腔穿刺、药物注射等治疗;④对本研究试验方案知情同意,并签署知情同意书。

1.4 排除标准 ①膝外翻畸形者;②膝关节疼痛导致不能下地或需助步器辅助行走者;③合并躯干、上肢、髋关节、踝关节、足部等影响下肢力线的疾病或损伤者;④合并严重的肺、肝、肾功能障碍及心脑血管疾病者;⑤合并脊髓损伤及脑性瘫痪、帕金森等疾病者;⑥合并创伤性关节炎、类风湿关节炎、膝关节肿瘤、化脓性关节炎、痛风、结核等其他膝关节疾病者;⑦有精神疾病病史者;⑧合并其他影响行走的疾病者。

2 方法

2.1 膝关节面夹角与股胫角测量方法 拍摄膝关节

负重位 X 线片,测量患侧膝关节面夹角与股胫角。膝关节面夹角:股骨内、外侧髁最低点之切线与胫骨平台最低点之切线的夹角[图 1(1)]。股胫角:股骨下段轴线与胫骨上段轴线形成的外侧夹角[图 1(2)]。

2.2 步态参数测试方法 采用浙江大学自主研发设计的 UTest 二维步态测试系统——动态平衡测试系统。患者以惯常步态自然行走在长约 250 cm 的测试板上,从一足迈入开始端至双足全部离开结束端为 1 次。每人测试 6 次,记录步速及患侧步长、步角、支撑期时间、支撑期百分数等步态参数。步速:每秒行走的距离。步长:行走时一足跟着地至对侧足跟着地的纵向直线距离(图 2)。步角:足的长轴与前进方向之间的夹角(图 2)。支撑期时间:从足跟着地到足尖离地所需的时间,即足部支撑地面的时间。支撑期百分数:足支撑地面的时间占整个步态周期的百分数。取 6 次测量结果的平均值。

2.3 数据统计方法 采用 SPSS17.0 统计软件处理数据。不同膝关节面夹角与不同股胫角患者步态参数的组间比较采用单因素方差分析,组间两两比较采用 q 检验;检验水准 $\alpha=0.05$ 。

3 结果

72 例患者,患侧膝关节面夹角 $0.2^{\circ} \sim 7.8^{\circ}$,中位

数 3.1° ($<1.0^{\circ}$ 13 例, $1.0^{\circ} \sim 3.5^{\circ}$ 34 例, $3.6^{\circ} \sim 8.0^{\circ}$ 25 例);股胫角 $170^{\circ} \sim 186^{\circ}$,中位数 178° ($170^{\circ} \sim 176^{\circ}$ 18 例, $177^{\circ} \sim 180^{\circ}$ 31 例, $181^{\circ} \sim 187^{\circ}$ 23 例)。不同膝关节面夹角患者的步角、步速、步长比较,组间差异均有统计学意义。膝关节面夹角 $<1.0^{\circ}$ 患者的步角小于膝关节面夹角 $1.0^{\circ} \sim 3.5^{\circ}$ 和 $3.6^{\circ} \sim 8.0^{\circ}$ 的患者 ($P=0.030, P=0.000$),膝关节面夹角 $1.0^{\circ} \sim 3.5^{\circ}$ 患者的步角小于膝关节面夹角 $3.6^{\circ} \sim 8.0^{\circ}$ 的患者 ($P=0.001$)。膝关节面夹角 $3.6^{\circ} \sim 8.0^{\circ}$ 患者的步速、步长均小于膝关节面夹角 $<1.0^{\circ}$ 和 $1.0^{\circ} \sim 3.5^{\circ}$ 的患者 ($P=0.000, P=0.000; P=0.000, P=0.000$),膝关节面夹角 $<1.0^{\circ}$ 患者的步速、步长与膝关节面夹角 $1^{\circ} \sim 3.5^{\circ}$ 患者相比,差异均无统计学意义 ($P=0.053, P=0.154$)。不同膝关节面夹角患者的步态支撑期时间、支撑期百分数的组间差异均无统计学意义。见表 1。不同股胫角患者的步角、步速、步长、支撑期时间、支撑期百分数比较,组间差异均无统计学意义(表 2)。

4 讨论

KOA 病变严重程度与下肢生物力线的改变有直接关系^[2]。KOA 患者往往合并膝内翻,导致下肢负重线逐渐移向膝关节内侧间室^[7]。Thorpe 等^[8]的研究发现膝内侧的动力负重升高程度与 KOA 的严重程

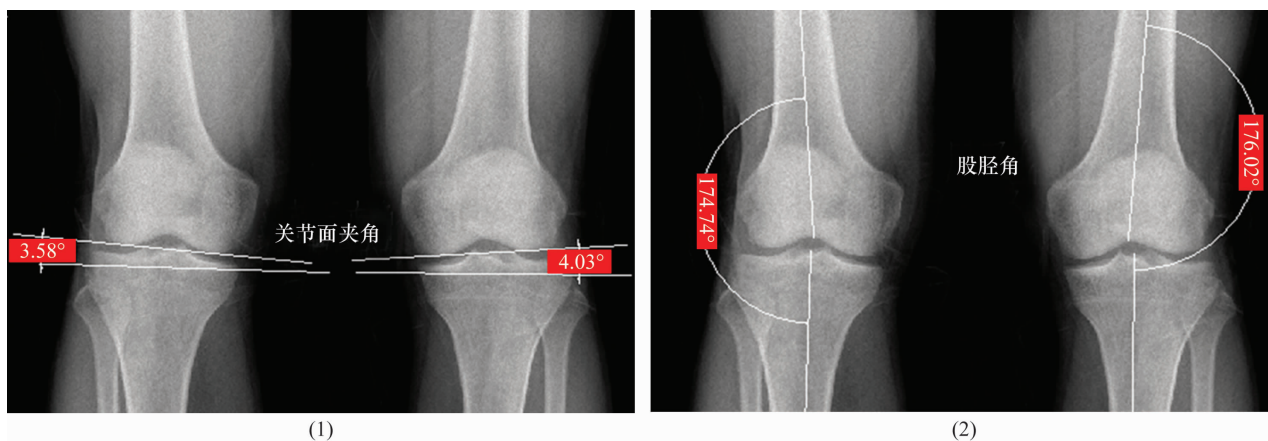


图 1 膝关节面夹角和股胫角测量 X 线片



图 2 步长和步角测量方法示意图

表 1 不同膝关节面夹角的膝骨关节炎患者步态参数比较 $\bar{x} \pm s$

膝关节面夹角	样本量 (例)	步态参数				
		步角($^{\circ}$)	步速($\text{cm} \cdot \text{s}^{-1}$)	步长(cm)	支撑期时间(s)	支撑期百分数
$<1.0^{\circ}$	13	12.28 ± 3.43	70.59 ± 9.88	55.71 ± 4.87	0.79 ± 0.06	$(63.92 \pm 6.34)\%$
$1.0^{\circ} \sim 3.5^{\circ}$	34	15.43 ± 3.83	62.15 ± 11.47	51.94 ± 4.17	0.86 ± 0.71	$(64.74 \pm 8.37)\%$
$3.6^{\circ} \sim 8.0^{\circ}$	25	20.50 ± 2.72	41.10 ± 7.90	36.78 ± 7.14	0.87 ± 0.12	$(66.74 \pm 7.31)\%$
<i>F</i> 值		18.571	27.621	40.272	0.811	0.421
<i>P</i> 值		0.000	0.000	0.000	0.453	0.660

表 2 不同股胫角的膝骨关节炎患者步态参数比较 $\bar{x} \pm s$

股胫角	样本量 (例)	步态参数				
		步角($^{\circ}$)	步速($\text{cm} \cdot \text{s}^{-1}$)	步长(cm)	支撑期时间(s)	支撑期百分数
$170^{\circ} \sim 176^{\circ}$	18	16.42 ± 4.88	56.71 ± 15.72	48.63 ± 9.92	0.90 ± 0.10	$(64.93 \pm 1.37)\%$
$177^{\circ} \sim 180^{\circ}$	31	13.93 ± 3.57	66.24 ± 11.13	53.51 ± 3.92	0.82 ± 0.08	$(64.54 \pm 0.89)\%$
$181^{\circ} \sim 187^{\circ}$	23	17.04 ± 5.43	55.38 ± 17.72	44.85 ± 11.54	0.90 ± 0.15	$(65.62 \pm 1.64)\%$
<i>F</i> 值		1.311	1.983	3.294	1.838	1.851
<i>P</i> 值		0.283	0.154	0.051	0.175	0.173

度、膝关节的疼痛及疾病的进展有密切的关系。随着下肢力线内移,膝关节外侧副韧带牵拉、内侧副韧带松弛,软组织失去平衡,致膝关节内翻。且软组织失衡越严重,膝关节内翻角度越大,关节间隙也越狭窄^[9-10]。膝关节面夹角是股骨内、外侧髁最低点之切线与胫骨平台最低点之切线的夹角,是对软组织平衡状态及内侧关节间隙狭窄度的反映^[11]。

股胫角是股骨下段轴线与胫骨上段轴线形成的外侧夹角,膝外翻时 $<165^{\circ}$ 、膝内翻时 $>175^{\circ}$,我国成人正常股胫角为 $174^{\circ} \sim 178^{\circ}$ ^[12-14]。股胫角改变对 KOA 步态的影响并不明显,可能与髋关节、股骨、胫骨及膝关节内外侧软组织等因素均能影响股胫角大小有关^[15-16]。

支撑期时间和支撑期百分数是两个相对独立的步态参数,受患者自身行走习惯及患膝疼痛程度等影响较大,目前大多用于 KOA 健患侧、治疗前后的对比。

本研究结果表明,KOA 患者患侧膝关节面夹角越大,步角越大、步速越慢、步长越短,步态支撑期时间、支撑期百分数则无明显变化;而股胫角的大小对 KOA 患者步态无明显影响。

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度和躯体功能,消除肿胀及综合疗效方面优于后者。

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