

· 临床研究 ·

# 电针足少阳经穴在膝关节前交叉韧带损伤术后 康复中的应用价值

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**摘要 目的:**探讨电针足少阳经穴在膝关节前交叉韧带(anterior cruciate ligament, ACL)损伤术后康复中的应用价值。**方法:**纳入膝关节 ACL 部分损伤患者 50 例。由同一组医生行膝关节镜下腓骨长肌腱单束 ACL 重建术, 术后第 2 天开始电针患侧足少阳经的悬钟、阳陵泉、膝阳关、环跳 4 穴。每天 1 次, 连续治疗 6 d 为 1 个疗程, 2 个疗程间隔 1 d, 共治疗 6 个疗程。比较治疗前及治疗开始后 2 周、4 周、6 周时双侧膝关节的被动活动察觉阈值(threshold to detection of passive motion, TTDPM)、关节位置觉(joint position sense, JPS)以及体感诱发电位(somatosensory evoked potentials, SEPs)P40 起始潜伏期、波幅和运动神经传导速度(motor nerve conduction velocity, MCV)潜伏期、波幅。**结果:**①TTDPM。时间因素和分组因素存在交互效应( $F=312.586, P=0.000$ )。双侧膝关节 TTDPM 总体比较, 差异有统计学意义, 即存在分组效应( $F=406.942, P=0.000$ )。治疗前后不同时间点间膝关节 TTDPM 的差异有统计学意义, 即存在时间效应( $F=334.592, P=0.000$ )。患侧膝关节 TTDPM 随时间呈下降趋势( $3.57^\circ \pm 0.53^\circ, 2.61^\circ \pm 0.47^\circ, 2.21^\circ \pm 0.39^\circ, 1.92^\circ \pm 0.28^\circ, F=349.201, P=0.000$ ), 健侧随时间无明显变化( $1.44^\circ \pm 0.10^\circ, 1.42^\circ \pm 0.12^\circ, 1.40^\circ \pm 0.10^\circ, 1.41^\circ \pm 0.07^\circ, F=2.772, P=0.052$ )。治疗前后各时间点, 患侧膝关节 TTDPM 均较健侧高( $t=29.528, P=0.000; t=21.642, P=0.000; t=16.658, P=0.000; t=13.642, P=0.000$ )。②JPS。时间因素和分组因素存在交互效应( $F=201.439, P=0.000$ )。双侧膝关节 JPS 总体比较, 差异有统计学意义, 即存在分组效应( $F=532.141, P=0.000$ )。治疗前后不同时间点间膝关节 JPS 的差异有统计学意义, 即存在时间效应( $F=209.843, P=0.000$ )。患侧膝关节 JPS 随时间呈改善趋势( $4.31^\circ \pm 0.71^\circ, 3.62^\circ \pm 0.65^\circ, 3.23^\circ \pm 0.60^\circ, 2.64^\circ \pm 0.54^\circ, F=211.272, P=0.000$ ), 健侧随时间无明显变化( $1.49^\circ \pm 0.13^\circ, 1.47^\circ \pm 0.11^\circ, 1.48^\circ \pm 0.10^\circ, 1.47^\circ \pm 0.10^\circ, F=1.333, P=0.277$ )。治疗前后各时间点, 患侧膝关节 JPS 均较健侧差( $t=28.782, P=0.000; t=23.278, P=0.000; t=20.698, P=0.000; t=15.864, P=0.000$ )。③SEPsP40 起始潜伏期。时间因素和分组因素存在交互效应( $F=740.633, P=0.000$ )。双侧膝关节 SEPsP40 起始潜伏期总体比较, 差异有统计学意义, 即存在分组效应( $F=12153.958, P=0.000$ )。治疗前后不同时间点间膝关节 SEPsP40 起始潜伏期的差异有统计学意义, 即存在时间效应( $F=817.474, P=0.000$ )。患侧膝关节 SEPsP40 起始潜伏期随时间呈缩短趋势[( $49.23 \pm 1.95$ ) ms, ( $43.87 \pm 1.81$ ) ms, ( $38.33 \pm 1.91$ ) ms, ( $34.68 \pm 1.39$ ) ms,  $F=1406.798, P=0.000$ ], 健侧随时间无明显变化[( $30.78 \pm 0.92$ ) ms, ( $30.42 \pm 1.15$ ) ms, ( $30.41 \pm 0.98$ ) ms, ( $30.39 \pm 1.10$ ) ms,  $F=1.680, P=0.173$ ]。治疗前后各时间点, 患侧膝关节 SEPsP40 起始潜伏期均较健侧长( $t=64.829, P=0.000; t=51.154, P=0.000; t=26.471, P=0.000; t=18.256, P=0.000$ )。④SEPsP40 波幅。时间因素和分组因素存在交互效应( $F=540.382, P=0.000$ )。双侧膝关节 SEPsP40 波幅总体比较, 差异有统计学意义, 即存在分组效应( $F=1309.833, P=0.000$ )。治疗前后不同时间点间膝关节 SEPsP40 波幅的差异有统计学意义, 即存在时间效应( $F=619.578, P=0.000$ )。患侧膝关节 SEPsP40 波幅随时间呈增高趋势[( $1.36 \pm 0.10$ ) mv, ( $1.67 \pm 0.11$ ) mv, ( $1.83 \pm 0.10$ ) mv, ( $1.97 \pm 0.09$ ) mv,  $F=926.454, P=0.000$ ], 健侧随时间无明显变化[( $2.27 \pm 0.08$ ) mv, ( $2.29 \pm 0.09$ ) mv, ( $2.28 \pm 0.06$ ) mv, ( $2.29 \pm 0.07$ ) mv,  $F=2.258, P=0.084$ ]。治疗前后各时间点, 患侧膝关节 SEPsP40 波幅均较健侧低( $t=-69.500, P=0.000; t=-42.342, P=0.000; t=-30.748, P=0.000; t=-22.211, P=0.000$ )。⑤MCV 潜伏期。时间因素和分组因素存在交互效应( $F=647.733, P=0.000$ )。双侧膝关节 MCV 潜伏期总体比较, 差异有统计学意义, 即存在分组效应( $F=828.428, P=0.000$ )。治疗前后不同时间点间膝关节 MCV 潜伏期的差异有统计学意义, 即存在时间效应( $F=673.718, P=0.000$ )。患侧膝关节 MCV 潜伏期随时间呈缩短趋势[( $20.63 \pm 1.37$ ) ms, ( $17.94 \pm 1.49$ ) ms, ( $16.67 \pm 1.30$ ) ms, ( $14.36 \pm 0.99$ ) ms,  $F=866.063, P=0.000$ ]; 健侧随时间无明显变化[( $12.27 \pm 0.39$ ) ms, ( $12.24 \pm 0.44$ ) ms, ( $12.22 \pm 0.49$ ) ms, ( $12.21 \pm 0.39$ ) ms,  $F=0.282, P=0.839$ ]。治疗前后各时间点, 患侧膝关节 MCV 潜伏期均较健侧长

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( $t = 44.622, P = 0.000; t = 26.899, P = 0.000; t = 27.612, P = 0.000; t = 15.341, P = 0.000$ )。⑥ MCV 波幅。时间因素和分组因素存在交互效应( $F = 2\,208.831, P = 0.000$ )。双侧膝关节 MCV 波幅总体比较,差异有统计学意义,即存在分组效应( $F = 3\,582.216, P = 0.000$ )。治疗前后不同时间点间膝关节 MCV 波幅的差异有统计学意义,即存在时间效应( $F = 2\,362.807, P = 0.000$ )。患侧膝关节 MCV 波幅随时间呈增高趋势[( $3.76 \pm 0.10$ )mv, ( $4.26 \pm 0.13$ )mv, ( $4.58 \pm 0.11$ )mv, ( $4.78 \pm 0.09$ )mv,  $F = 4\,397.711, P = 0.000$ ],健侧随时间无明显变化[( $5.23 \pm 0.07$ )mv, ( $5.24 \pm 0.06$ )mv, ( $5.23 \pm 0.06$ )mv, ( $5.24 \pm 0.05$ )mv,  $F = 2.144, P = 0.098$ ]。治疗前后各时间点,患侧膝关节 MCV 波幅均较健侧低( $t = -171.500, P = 0.000; t = -63.024, P = 0.000; t = -48.938, P = 0.000; t = -40.251, P = 0.000$ )。结论:对于膝关节 ACL 部分损伤患者,在 ACL 重建术后采用电针足少阳经穴,膝关节本体感觉可有一定程度的改善,但术后短期内并不能完全恢复。

**关键词** 膝损伤;前交叉韧带;电针;胆经;本体感觉;穴,悬钟;穴,阳陵泉;穴,膝阳关;穴,环跳

## Application value of electroacupuncture at points of foot Shaoyang meridian in postoperative rehabilitation of anterior cruciate ligament injuries

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**ABSTRACT** **Objective:** To explore the applied value of electroacupuncture(EA) at points of foot Shaoyang meridian in postoperative rehabilitation of anterior cruciate ligament(ACL) injuries. **Methods:** Fifty patients with partial ACL injuries were enrolled in the study, and they were treated with arthroscopic ACL reconstruction with single-bundle peroneus longus tendon by the same surgeons. The EA was performed at points of Xuanzhong(GB39), Yanglingquan(GB34), Xiyangguan(GB33) and Huantiao(GB30) at affected side from the postoperative day 2, once a day for consecutive 6 courses of treatment, 6 days for each course with a 1-day rest-insertion between courses. The threshold to detection of passive motion(TTDPM), joint position sense(JPS), onset latency(OL) and amplitude of somatosensory evoked potentials(SEPs)P40 as well as latency and amplitude of motor nerve conduction velocity(MCV) were compared between affected knee and unaffected knee before the treatment and at 2, 4 and 6 weeks after the beginning of the treatment respectively. **Results:** ① There was interaction between time factor and group factor in knee TTDPM( $F = 312.586, P = 0.000$ ). There was statistical difference in TTDPM between affected knee and unaffected knee in general, in other words, there was group effect( $F = 406.942, P = 0.000$ ). There was statistical difference in TTDPM between different timepoints before and after the treatment, in other words, there was time effect( $F = 334.592, P = 0.000$ ). The TTDPM presented a downward trend over time in affected knee( $3.57 \pm 0.53, 2.61 \pm 0.47, 2.21 \pm 0.39, 1.92 \pm 0.28$  degrees,  $F = 349.201, P = 0.000$ ), whereas it displayed no evident change over time in unaffected knee( $1.44 \pm 0.10, 1.42 \pm 0.12, 1.40 \pm 0.10, 1.41 \pm 0.07$  degrees,  $F = 2.772, P = 0.052$ ). The TTDPM was higher in affected knee compared to unaffected knee at each timepoint before and after the treatment( $t = 29.528, P = 0.000; t = 21.642, P = 0.000; t = 16.658, P = 0.000; t = 13.642, P = 0.000$ ). ② There was interaction between time factor and group factor in knee JPS( $F = 201.439, P = 0.000$ ). There was statistical difference in JPS between affected knee and unaffected knee in general, in other words, there was group effect( $F = 532.141, P = 0.000$ ). There was statistical difference in knee JPS between different timepoints before and after the treatment, in other words, there was time effect( $F = 209.843, P = 0.000$ ). The JPS presented an improving trend over time in affected knee( $4.31 \pm 0.71, 3.62 \pm 0.65, 3.23 \pm 0.60, 2.64 \pm 0.54$  degrees,  $F = 211.272, P = 0.000$ ), whereas it displayed no evident change over time in unaffected knee( $1.49 \pm 0.13, 1.47 \pm 0.11, 1.48 \pm 0.10, 1.47 \pm 0.10$  degrees,  $F = 1.333, P = 0.277$ ). The JPS was poorer in affected knee compared to unaffected knee at each timepoint before and after the treatment( $t = 28.782, P = 0.000; t = 23.278, P = 0.000; t = 20.698, P = 0.000; t = 15.864, P = 0.000$ ). ③ There was interaction between time factor and group factor in OL of SEPsP40( $F = 740.633, P = 0.000$ ). There was statistical difference in OL of SEPsP40 between affected knee and unaffected knee in general, in other words, there was group effect( $F = 12\,153.958, P = 0.000$ ). There was statistical difference in OL of SEPsP40 of knee between different timepoints before and after the treatment, in other words, there was time effect( $F = 817.474, P = 0.000$ ). The OL of SEPsP40 presented a shortening trend over time in affected knee( $49.23 \pm 1.95, 43.87 \pm 1.81, 38.33 \pm 1.91, 34.68 \pm 1.39$  ms,  $F = 1\,406.798, P = 0.000$ ), whereas it displayed no evident change over time in unaffected knee( $30.78 \pm 0.92, 30.42 \pm 1.15, 30.41 \pm 0.98, 30.39 \pm 1.10$  ms,  $F = 1.680, P = 0.173$ ). The OL of SEPsP40 was longer in affected knee compared to unaffected knee at each timepoint before and after the treatment( $t = 64.829, P = 0.000; t = 51.154, P = 0.000; t = 26.471, P = 0.000; t = 18.256, P =$

0.000)。④There was interaction between time factor and group factor in amplitude of SEPsP40 ( $F = 540.382, P = 0.000$ )。There was statistical difference in amplitude of SEPsP40 between affected knee and unaffected knee in general, in other words, there was group effect ( $F = 1309.833, P = 0.000$ )。There was statistical difference in amplitude of SEPsP40 of knee between different timepoints before and after the treatment, in other words, there was time effect ( $F = 619.578, P = 0.000$ )。The amplitude of SEPsP40 presented an increasing trend over time in affected knee ( $1.36 \pm 0.10, 1.67 \pm 0.11, 1.83 \pm 0.10, 1.97 \pm 0.09$  mv,  $F = 926.454, P = 0.000$ ) , whereas it displayed no evident change over time in unaffected knee ( $2.27 \pm 0.08, 2.29 \pm 0.09, 2.28 \pm 0.06, 2.29 \pm 0.07$  mv,  $F = 2.258, P = 0.084$ )。The amplitude of SEPsP40 was lower in affected knee compared to unaffected knee at each timepoint before and after the treatment ( $t = -69.500, P = 0.000; t = -42.342, P = 0.000; t = -30.748, P = 0.000; t = -22.211, P = 0.000$ )。⑤There was interaction between time factor and group factor in latency of MCV ( $F = 647.733, P = 0.000$ )。There was statistical difference in latency of MCV between affected knee and unaffected knee in general, in other words, there was group effect ( $F = 828.428, P = 0.000$ )。There was statistical difference in latency of MCV of knee between different timepoints before and after the treatment, in other words, there was time effect ( $F = 673.718, P = 0.000$ )。The latency of MCV presented a shortening trend over time in affected knee ( $20.63 \pm 1.37, 17.94 \pm 1.49, 16.67 \pm 1.30, 14.36 \pm 0.99$  ms,  $F = 866.063, P = 0.000$ ) , whereas it displayed no evident change over time in unaffected knee ( $12.27 \pm 0.39, 12.24 \pm 0.44, 12.22 \pm 0.49, 12.21 \pm 0.39$  ms,  $F = 0.282, P = 0.839$ )。The latency of MCV was longer in affected knee compared to unaffected knee at each timepoint before and after the treatment ( $t = 44.622, P = 0.000; t = 26.899, P = 0.000; t = 27.612, P = 0.000; t = 15.341, P = 0.000$ )。⑥There was interaction between time factor and group factor in amplitude of MCV ( $F = 2208.831, P = 0.000$ )。There was statistical difference in amplitude of MCV between affected knee and unaffected knee in general, in other words, there was group effect ( $F = 3582.216, P = 0.000$ )。There was statistical difference in amplitude of MCV of knee between different timepoints before and after the treatment, in other words, there was time effect ( $F = 2362.807, P = 0.000$ )。The amplitude of MCV presented an increasing trend over time in affected knee ( $3.76 \pm 0.10, 4.26 \pm 0.13, 4.58 \pm 0.11, 4.78 \pm 0.09$  mv,  $F = 4397.711, P = 0.000$ ) , whereas it displayed no evident change over time in unaffected knee ( $5.23 \pm 0.07, 5.24 \pm 0.06, 5.23 \pm 0.06, 5.24 \pm 0.05$  mv,  $F = 2.144, P = 0.098$ )。The amplitude of MCV was lower in affected knee compared to unaffected knee at each timepoint before and after the treatment ( $t = -171.500, P = 0.000; t = -63.024, P = 0.000; t = -48.938, P = 0.000; t = -40.251, P = 0.000$ )。 **Conclusion:** EA at points of foot Shaoyang meridian can improve the knee proprioception to some extent in patients who underwent ACL reconstruction for partial ACL injuries, but the knee proprioception can't be completely recovered in the short term after surgery.

**Keywords** knee injuries; anterior cruciate ligament; electroacupuncture; gallbladder meridian; proprioception; Point GB39 (Xuanzhong); Point GB34 (Yanglingquan); Point GB33 (Xiyangguan); Point GB30 (Huantiao)

膝关节前交叉韧带 (anterior cruciate ligament, ACL) 损伤是一种常见的非接触性运动损伤<sup>[1]</sup>, 可引起膝关节失稳及活动受限。目前, ACL 损伤主要采用手术治疗, 主流治疗方式为 ACL 重建术<sup>[2-3]</sup>。但 ACL 损伤会导致 ACL 上的本体感受器减少, 反馈信息传入障碍<sup>[4]</sup>。而膝关节周围的本体感觉在控制关节活动、校正姿势和维持平衡等方面具有重要作用<sup>[5]</sup>。ACL 重建术虽然可恢复膝关节的生物力学稳定性, 但移植物并不能替代原有 ACL 在膝关节本体感觉中应有的作用<sup>[6]</sup>。因此, 术后针对本体感觉的康复治疗对 ACL 损伤患者术后膝关节功能的恢复非常重要。中医有“少阳主骨”“骨繇者取之少阳”之说, 认为足少阳胆经与骨的生理、病理有密切关系<sup>[7]</sup>, 少阳经上的穴位可用于骨性疾病的治疗<sup>[8]</sup>, “骨繇”即骨关节纵缓且摇动不安, 与膝关节本体感觉障碍、失稳的表现相当。动物实验<sup>[9]</sup>表明, 电针刺激可改善模

型动物的本体感觉。为进一步探讨电针足少阳经穴在膝关节 ACL 损伤术后康复中的应用价值, 2019 年 1 月至 2020 年 8 月, 我们对 50 例膝关节 ACL 部分损伤患者在术后进行了电针足少阳经穴的治疗, 并对治疗前后患者双侧膝关节本体感觉的检测结果进行了比较, 现总结报告如下。

## 1 临床资料

**1.1 一般资料** ACL 损伤患者 50 例, 均为西南医科大学附属中医医院住院患者。男 28 例, 女 22 例。年龄 20 ~ 38 岁, 中位数 25 岁。本研究方案经医院伦理委员会审查通过 (批准文件号: KY2020087 - FS01)。

**1.2 纳入标准** ①年龄 18 ~ 60 岁; ②MRI 示单侧 ACL 部分损伤 (图 1); ③有明确外伤史; ④受伤至本次就诊时间 ≤ 6 个月; ⑤对本研究方案知情同意, 并签署知情同意书。

**1.3 排除标准** ①合并膝关节结核、感染者; ②合并

后交叉韧带、侧副韧带及半月板损伤者;③有膝关节手术史者;④合并膝关节骨关节炎者;⑤合并神经系统疾病者;⑥预计依从性差者。

## 2 方 法

**2.1 治疗方法** 由同一组医生行膝关节镜下腓骨长肌腱单束 ACL 重建术。术后第 2 天开始电针治疗。取穴:取患侧少阳经穴悬钟、阳陵泉、膝阳关、环跳。悬钟穴,外踝尖直上 4 横指、腓骨前缘处;阳陵泉穴,腓骨小头前下方凹陷处;膝阳关穴,股二头肌腱与髂胫束之间的凹陷中;环跳穴,侧卧屈股,股外侧,当股骨大转子最凸点与骶管裂孔连线的外 1/3 与中 1/3 交点处。操作方法:局部皮肤常规消毒,毫针刺,悬钟穴直刺 0.5 寸、阳陵泉穴直刺 1 寸、膝阳关穴直刺 1 寸、环跳穴直刺 2.0~2.5 寸。平补平泻行针 1 min 后,连接青岛鑫升 G6805-I 型电针仪,逐穴刺激,疏密波,频率 15 Hz,每穴留针 10 min。每日 1 次,连续治疗 6 d 为 1 个疗程,2 个疗程间隔 1 d,共治疗 6 个疗程。

**2.2 疗效评价方法** 比较治疗前及治疗开始后 2 周、4 周、6 周时双侧膝关节的被动活动察觉阈值(threshold to detection of passive motion, TTDPM)、关节位置觉(joint position sense, JPS)以及体感诱发电位(somatosensory evoked potentials, SEPs) P40 起始潜伏期、波幅和运动神经传导速度(motor nerve conduction velocity, MCV)潜伏期、波幅。

**2.2.1 TTDPM 检测方法** 患者仰卧位,蒙住患者眼

睛和耳朵,膝关节屈曲  $20^\circ$  (开始计时),在 BiodexS4 等速肌力训练装置的作用下以  $0.25^\circ \cdot s^{-1}$  的速度伸直膝关节,当患者感觉膝关节伸直时立即告诉研究者(停止计时)。双侧各测 3 次,两次操作之间休息 30 s。计算 3 次所测结果的平均值后乘以  $0.25^\circ \cdot s^{-1}$  作为检测结果。

**2.2.2 JPS 检测方法** 患者仰卧位,膝关节屈曲  $20^\circ$ ,在 BiodexS4 等速肌力训练装置的作用下以  $2.5^\circ \cdot s^{-1}$  的速度伸直膝关节。当患者感觉膝关节伸直直到相应测定角度时立即告诉研究者,并在此处停留 5 s。记录此时膝关节实际伸直角度,计算测定角度与膝关节实际伸直角度的差值。连续检测 3 次,每次检测测定角度均取  $30^\circ$  和  $60^\circ$ ,两次检测之间休息 30 s。计算 3 次所测结果的平均值作为检测结果。

**2.2.3 SEPs 检测方法** 肌电诱发电位仪记录电极置于头颅 Cz' 点(下肢躯体感觉中枢),参考电极置于 Fz 点,地线接于小腿,刺激电极分别置于双侧腓窝 ACL 股骨附着处对应的体表处。方波脉冲刺激,波宽 0.2 ms,强度为感觉阈的 2.5 倍,叠加 150 次。记录双侧 SEPsP40 起始潜伏期及波幅。

**2.2.4 MCV 检测方法** 肌电诱发电位仪记录电极置于腓绳肌肌腹,旁开 2 cm 放置参考电极,表面双极刺激电极分别置于双侧腓窝 ACL 股骨附着处对应的体表处。方波脉冲刺激,波宽 0.2 ms,强度为 25~30 mA。记录双侧 MCV 潜伏期及波幅。

**2.3 数据统计方法** 采用 SPSS25.0 统计软件处理

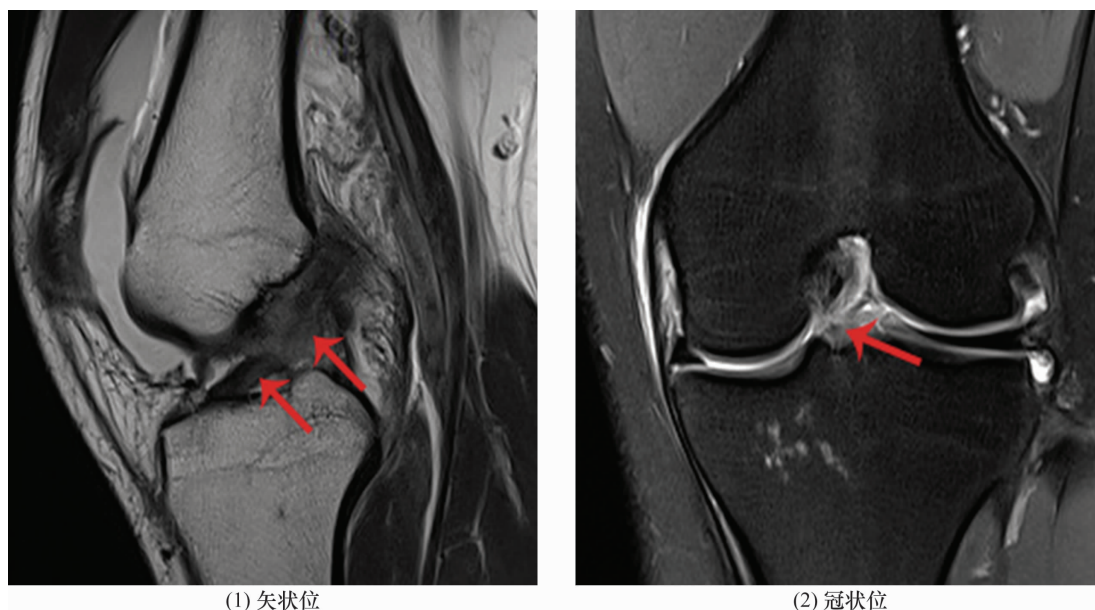


图 1 膝关节前交叉韧带部分损伤 MRI

注:红色箭头处示前交叉韧带损伤。

数据。治疗前后不同时间点双侧膝关节的 TTDPM、JPS、SEPsP40 起始潜伏期、SEPsP40 波幅、MCV 潜伏期、MCV 波幅的比较均采用重复测量资料的方差分析。检验水准  $\alpha = 0.05$ 。

### 3 结果

**3.1 TTDPM** 时间因素和分组因素存在交互效应。双侧膝关节 TTDPM 总体比较,差异有统计学意义,即存在分组效应。治疗前后不同时间点间膝关节 TTDPM 的差异有统计学意义,即存在时间效应。患侧膝关节 TTDPM 随时间呈下降趋势,健侧随时间无明显变化。治疗前后各时间点,患侧膝关节 TTDPM 均较健侧高。见表 1、图 2(1)。

**3.2 JPS** 时间因素和分组因素存在交互效应。双侧膝关节 JPS 总体比较,差异有统计学意义,即存在分组效应。治疗前后不同时间点间膝关节 JPS 的差异有统计学意义,即存在时间效应。患侧膝关节 JPS 随时间呈改善趋势,健侧随时间无明显变化。治疗前后各时间点,患侧膝关节 JPS 均较健侧差。见表 2、图 2(2)。

**3.3 SEPsP40 起始潜伏期** 时间因素和分组因素存在交互效应。双侧膝关节 SEPsP40 起始潜伏期总体比较,差异有统计学意义,即存在分组效应。治疗前后不同时间点间膝关节 SEPsP40 起始潜伏期的差异有统计学意义,即存在时间效应。患侧膝关节

SEPsP40 起始潜伏期随时间呈缩短趋势,健侧随时间无明显变化。治疗前后各时间点,患侧膝关节 SEPsP40 起始潜伏期均较健侧长。见表 3、图 2(3)。

**3.4 SEPsP40 波幅** 时间因素和分组因素存在交互效应。双侧膝关节 SEPsP40 波幅总体比较,差异有统计学意义,即存在分组效应。治疗前后不同时间点间膝关节 SEPsP40 波幅的差异有统计学意义,即存在时间效应。患侧膝关节 SEPsP40 波幅随时间呈增高趋势,健侧随时间无明显变化。治疗前后各时间点,患侧膝关节 SEPsP40 波幅均较健侧低。见表 4、图 2(4)。

**3.5 MCV 潜伏期** 时间因素和分组因素存在交互效应。双侧膝关节 MCV 潜伏期总体比较,差异有统计学意义,即存在分组效应。治疗前后不同时间点间膝关节 MCV 潜伏期的差异有统计学意义,即存在时间效应。患侧膝关节 MCV 潜伏期随时间呈缩短趋势,健侧随时间无明显变化。治疗前后各时间点,患侧膝关节 MCV 潜伏期均较健侧长。见表 5、图 2(5)。

**3.6 MCV 波幅** 时间因素和分组因素存在交互效应。双侧膝关节 MCV 波幅总体比较,差异有统计学意义,即存在分组效应。治疗前后不同时间点间膝关节 MCV 波幅的差异有统计学意义,即存在时间效应。患侧膝关节 MCV 波幅随时间呈增高趋势,健侧随时间无明显变化。治疗前后各时间点,患侧膝关节 MCV 波幅均较健侧低。见表 6、图 2(6)。

表 1 50 例膝关节前交叉韧带损伤患者治疗前后不同时间点双侧膝关节被动活动察觉阈值

侧别	样本量/ 膝	膝关节被动活动察觉阈值/ $(\bar{x} \pm s, ^\circ)$					F 值	P 值
		治疗前	治疗开始后 2 周	治疗开始后 4 周	治疗开始后 6 周	合计		
患侧	50	3.57 $\pm$ 0.53	2.61 $\pm$ 0.47	2.21 $\pm$ 0.39	1.92 $\pm$ 0.28	2.58 $\pm$ 0.75	349.201	0.000
健侧	50	1.44 $\pm$ 0.10	1.42 $\pm$ 0.12	1.40 $\pm$ 0.10	1.41 $\pm$ 0.07	1.42 $\pm$ 0.10	2.772	0.052
合计		2.50 $\pm$ 1.13	2.02 $\pm$ 0.69	1.80 $\pm$ 0.49	1.66 $\pm$ 0.33	2.00 $\pm$ 0.79	334.592 <sup>1)</sup>	0.000 <sup>1)</sup>
t 值		t = 29.528	t = 21.642	t = 16.658	t = 13.642	406.942 <sup>1)</sup>	F = 312.586 <sup>2)</sup> ,	
P 值		0.000	0.000	0.000	0.000	0.000 <sup>1)</sup>	P = 0.000 <sup>2)</sup>	

1) 主效应的 F 值和 P 值; 2) 交互效应的 F 值和 P 值。

表 2 50 例膝关节前交叉韧带损伤患者治疗前后不同时间点双侧膝关节位置觉

侧别	样本量/ 膝	膝关节位置觉/ $(\bar{x} \pm s, ^\circ)$					F 值	P 值
		治疗前	治疗开始后 2 周	治疗开始后 4 周	治疗开始后 6 周	合计		
患侧	50	4.31 $\pm$ 0.71	3.62 $\pm$ 0.65	3.23 $\pm$ 0.60	2.64 $\pm$ 0.54	3.45 $\pm$ 0.87	211.272	0.000
健侧	50	1.49 $\pm$ 0.13	1.47 $\pm$ 0.11	1.48 $\pm$ 0.10	1.47 $\pm$ 0.10	1.48 $\pm$ 0.11	1.333	0.277
合计		2.90 $\pm$ 1.50	2.55 $\pm$ 1.18	2.35 $\pm$ 0.98	2.05 $\pm$ 0.71	2.46 $\pm$ 1.17	209.843 <sup>1)</sup>	0.000 <sup>1)</sup>
t 值		t = 28.782	t = 23.278	t = 20.698	t = 15.864	532.141 <sup>1)</sup>	F = 201.439 <sup>2)</sup> ,	
P 值		0.000	0.000	0.000	0.000	0.000 <sup>1)</sup>	P = 0.000 <sup>2)</sup>	

1) 主效应的 F 值和 P 值; 2) 交互效应的 F 值和 P 值。

表 3 50 例膝关节前交叉韧带损伤患者治疗前后不同时间点双侧膝关节体感诱发电位 P40 起始潜伏期

侧别	样本量/ 膝	膝关节体感诱发电位 P40 起始潜伏期/ $(\bar{x} \pm s, ms)$					F 值	P 值
		治疗前	治疗开始后 2 周	治疗开始后 4 周	治疗开始后 6 周	合计		
患侧	50	49.23 ± 1.95	43.87 ± 1.81	38.33 ± 1.91	34.68 ± 1.39	41.53 ± 5.81	1 406.798	0.000
健侧	50	30.78 ± 0.92	30.42 ± 1.15	30.41 ± 0.98	30.39 ± 1.10	30.50 ± 1.05	1.680	0.173
合计		40.00 ± 9.39	37.15 ± 6.93	34.37 ± 4.26	32.53 ± 2.49	36.01 ± 6.92	817.474 <sup>1)</sup>	0.000 <sup>1)</sup>
t 值		t = 64.829	t = 51.154	t = 26.471	t = 18.256	12 153.958 <sup>1)</sup>	F = 740.633 <sup>2)</sup> , P = 0.000 <sup>2)</sup>	
P 值		0.000	0.000	0.000	0.000	0.000 <sup>1)</sup>		

1) 主效应的 F 值和 P 值; 2) 交互效应的 F 值和 P 值。

表 4 50 例膝关节前交叉韧带损伤患者治疗前后不同时间点双侧膝关节体感诱发电位 P40 波幅

侧别	样本量/ 膝	膝关节体感诱发电位 P40 波幅/ $(\bar{x} \pm s, mv)$					F 值	P 值
		治疗前	治疗开始后 2 周	治疗开始后 4 周	治疗开始后 6 周	合计		
患侧	50	1.36 ± 0.10	1.67 ± 0.11	1.83 ± 0.10	1.97 ± 0.09	1.71 ± 0.25	926.454	0.000
健侧	50	2.27 ± 0.08	2.29 ± 0.09	2.28 ± 0.06	2.29 ± 0.07	2.28 ± 0.07	2.258	0.084
合计		1.82 ± 0.47	1.98 ± 0.32	2.05 ± 0.24	2.13 ± 0.18	1.99 ± 0.34	619.578 <sup>1)</sup>	0.000 <sup>1)</sup>
t 值		t = -69.500	t = -42.342	t = -30.748	t = -22.211	1 309.833 <sup>1)</sup>	F = 540.382 <sup>2)</sup> , P = 0.000 <sup>2)</sup>	
P 值		0.000	0.000	0.000	0.000	0.000 <sup>1)</sup>		

1) 主效应的 F 值和 P 值; 2) 交互效应的 F 值和 P 值。

表 5 50 例膝关节前交叉韧带损伤患者治疗前后不同时间点双侧膝关节运动神经传导速度潜伏期

侧别	样本量/ 膝	膝关节运动神经传导速度潜伏期/ $(\bar{x} \pm s, ms)$					F 值	P 值
		治疗前	治疗开始后 2 周	治疗开始后 4 周	治疗开始后 6 周	合计		
患侧	50	20.63 ± 1.37	17.94 ± 1.49	16.67 ± 1.30	14.36 ± 0.99	17.40 ± 2.61	886.063	0.000
健侧	50	12.27 ± 0.39	12.24 ± 0.44	12.22 ± 0.49	12.21 ± 0.39	12.24 ± 0.43	0.282	0.839
合计		16.45 ± 4.32	15.09 ± 3.07	14.45 ± 2.44	13.29 ± 1.31	14.82 ± 3.19	673.718 <sup>1)</sup>	0.000 <sup>1)</sup>
t 值		t = 44.622	t = 26.899	t = 27.612	t = 15.341	828.428 <sup>1)</sup>	F = 647.733 <sup>2)</sup> , P = 0.000 <sup>2)</sup>	
P 值		0.000	0.000	0.000	0.000	0.000 <sup>1)</sup>		

1) 主效应的 F 值和 P 值; 2) 交互效应的 F 值和 P 值。

表 6 50 例膝关节前交叉韧带损伤患者治疗前后不同时间点双侧膝关节运动神经传导速度波幅

侧别	样本量/ 膝	膝关节运动神经传导速度波幅/ $(\bar{x} \pm s, mv)$					F 值	P 值
		治疗前	治疗开始后 2 周	治疗开始后 4 周	治疗开始后 6 周	合计		
患侧	50	3.76 ± 0.10	4.26 ± 0.13	4.58 ± 0.11	4.78 ± 0.09	4.34 ± 0.40	4 397.711	0.000
健侧	50	5.23 ± 0.07	5.24 ± 0.06	5.23 ± 0.06	5.24 ± 0.05	5.23 ± 0.06	2.144	0.098
合计		4.49 ± 0.74	4.75 ± 0.51	4.91 ± 0.34	5.01 ± 0.24	4.79 ± 0.53	2 362.807 <sup>1)</sup>	0.000 <sup>1)</sup>
t 值		t = -171.500	t = -63.024	t = -48.938	t = -40.251	3 582.216 <sup>1)</sup>	F = 2 208.831 <sup>2)</sup> , P = 0.000 <sup>2)</sup>	
P 值		0.000	0.000	0.000	0.000	0.000 <sup>1)</sup>		

1) 主效应的 F 值和 P 值; 2) 交互效应的 F 值和 P 值。

## 4 讨 论

大脑中枢接收的来自肌肉、肌腱、韧带及关节等处的本体感受器在不同状态下所感知到的信息称为本体感觉,主要包括位置觉、运动觉及震动觉<sup>[10-11]</sup>。本体感受器将信息传入中枢神经系统,引起神经反射,调节肌肉、肌腱、韧带等的状态以维持人体的稳定<sup>[12-13]</sup>。ACL 上的本体感受器受到刺激后,可通过 ACL-腘绳肌反射弧引起腘绳肌收缩,进而对抗胫骨前移,起到保护 ACL、维持膝关节稳定的作用<sup>[14]</sup>。ACL 损伤后,不仅本体感受器会随损伤时间的延长

而减少导致本体感觉降低,而且维持膝关节稳定的 ACL-腘绳肌反射弧会受损,致使膝关节稳定性下降<sup>[15-16]</sup>。

多项研究表明<sup>[17-18]</sup>,目前治疗膝关节损伤,恢复膝关节的稳定性,不仅依赖于生物力学重建,更依赖于本体感觉的恢复。ACL 重建术虽能较好恢复 ACL 张力,但术后仍存在关节不稳的现象<sup>[19]</sup>。ACL 重建时保留损伤残余物可加速移植物的血运重建、改善本体感觉,但保留的残余物可能会发生独眼龙征<sup>[20]</sup>,此类技术的应用也存在争议<sup>[21-23]</sup>。



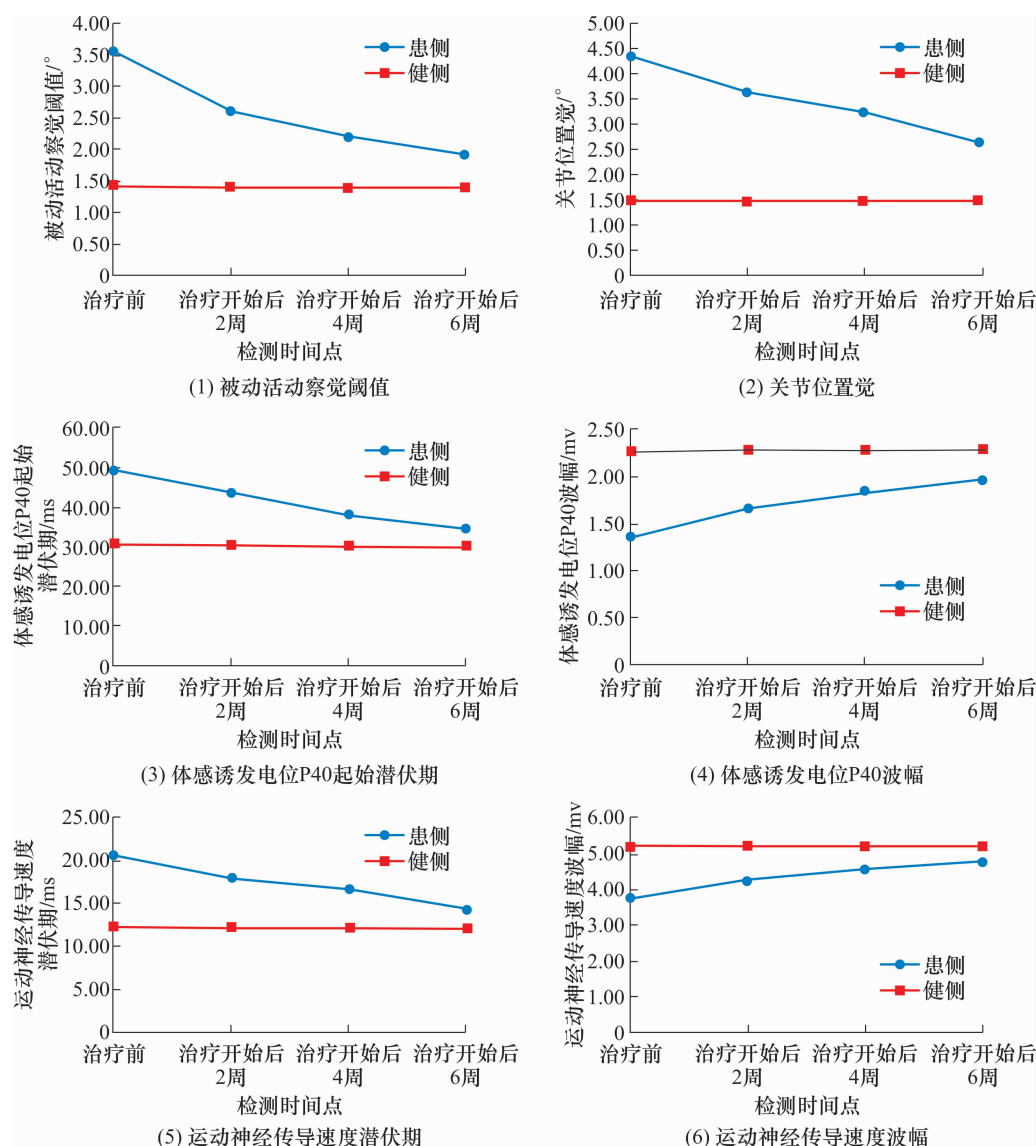


图 2 50 例膝关节前交叉韧带损伤患者电针足少阳经穴治疗前后双侧膝关节本体感觉变化图

《灵枢·经脉》载:“胆足少阳之脉……是主骨所生病者……膝外至脛、绝骨、外踝前及诸节皆痛。”《灵枢·根结》载:“少阳为枢……枢折,即骨繇而不安于地,故骨繇者取之少阳。”即足少阳经脉失常,则“诸节皆痛”,进而“骨繇而不安于地”。因此,治疗膝关节本体感觉障碍可取足少阳经的经穴。悬钟、阳陵泉、膝阳关、环跳 4 穴均为足少阳经穴,其中悬钟穴为八会穴之髓会,髓为骨之精华,可治疗筋脉失养之下肢痿痹;阳陵泉穴为八会穴之筋会,可强筋骨、通经络,是治疗筋病骨痹要穴;膝阳关穴为治疗膝关节病变的常用穴,能舒筋利节;环跳穴为足少阳胆经和足太阳膀胱经的交会穴,能通经活络、强健腰膝筋骨。而电针刺激在缓解疼痛,改善运动功能方面具有明确的作用<sup>[24-25]</sup>。电针干预可以预防膝关节本体感觉退化<sup>[26-27]</sup>。

本研究结果表明,对于膝关节 ACL 部分损伤患

者,在前交叉韧带重建术后采用电针足少阳经穴,膝关节本体感觉可有一定程度的改善,但术后短期内并不能完全恢复。该方法的疗效还需长期随访研究进一步证实。

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