·临床研究·

脑卒中偏瘫足内翻患者步行支撑期的足底压力特征

胡楠　毕胜　卢茜　邓思宇　郄淑燕　刘畅　张佳玮

【摘　要】 **目的**　探讨可描述脑卒中偏瘫患者步行支撑期足内翻的足底压力学参数。**方法**　选取能独立步行的脑卒中偏瘫患者 22 例设为病例组，另选与患者年龄、体重相匹配的中老年健康志愿者 17 例设为对照组，使用 Footscan 压力板测量受试者常速行走下的足底压力，采集双足各 3 次的动态足底压力，得到足内外侧压强比值，记录并分析患者行走时足底各区域的压强峰值和接触面积（本研究所呈现的数据均为某个区域参数相对于所有分区对应参数之和的百分比）。并使用临床痉挛指数（CSI）评价患者患侧踝关节的痉挛程度，并比较对照组健康人与病例组患者健患侧之间上述参数的差异及其相关性。**结果**　①病例组患侧前足内侧压强占所有分区之和的百分比[（23.52 ± 10.15）%]小于对照组优势侧[（29.82 ± 7.45）%]，而前足外侧压强的百分比[（45.45 ± 17.71）%]大于对照组优势侧[（37.47 ± 12.60）%]；病例组健侧第 1 趾压强的所占百分比[（9.04 ± 7.47）%]小于对照组优势侧[（14.84 ± 6.54）%]，而病例组中足及足跟压强的所占百分比[患侧（38.17 ± 13.57）%，健侧（49.61 ± 26.36）%]均大于对照组优势侧[（25.05 ± 4.92）%]，且组间差异均有统计学意义（$P < 0.05$）；病例组患侧前足外侧压强的所占百分比[（45.45 ± 17.71）%]大于组内患者健侧[（37.04 ± 22.09）%]，且差异有统计学意义（$P < 0.05$）。②病例组患侧第 1 趾接触面积占全足的百分比[（9.96 ± 1.67）%]大于对照组优势侧[（8.57 ± 1.17）%]，前足内侧接触面积占全足的百分比[（14.71 ± 4.64）%]小于对照组优势侧[（17.62 ± 1.52）%]，且组间差异均有统计学意义（$P < 0.05$）；病例组其余各区域健患侧组内比较，差异无统计学意义（$P > 0.05$）。③病例组患侧全足、前足内外侧压强比值最大值[（27.21 ± 22.73）、（22.81 ± 22.19）]明显小于对照组优势侧[（43.68 ± 23.78）、（41.09 ± 28.13）]，组间差异均有统计学意义（$P < 0.05$），而足跟的足内外侧压强比值的最大值组间比较以及健患侧之间全足、前足及足跟足内外侧压强比值的最大值比较，差异均无统计学意义（$P > 0.05$），但有患侧小于对照组优势侧及患侧小于健侧的趋势（$P > 0.05$）。④病例组健患侧足在支撑期翻转程度减小，整体呈内翻。⑤病例组经 CSI 评定有轻度痉挛 13 例，中度痉挛 5 例，重度痉挛 4 例。病例组患侧总体的踝关节 CSI 得分（10.26 ± 3.38）分，95% 可信区间位于 8.63 ~ 11.89。病例组患侧全足的内外侧压强比值最大值与前足外侧压强呈中度负相关（$r = -0.516$，$P < 0.05$），与接触面积及 CSI 无关（$P > 0.05$）。**结论**　足底压力可定量描述脑卒中偏瘫患者的足内翻，足内外侧压强比值的最大值是反映脑卒中偏瘫患者足内翻的有效指标。

【关键词】 脑卒中；　偏瘫；　足底压力；　足内翻

Foot inversion during walking among hemiplegic stroke survivors　*Hu Nan*[*], *Bi Sheng*, *Lu Xi*, *Deng Siyu*, *Qi Shuyan*, *Liu Chang*, *Zhang Jiawei*. [*]*Center of Rehabilitation Medicine, General Hospital of the PLA, Beijing 100853, China*

Corresponding author: Bi Sheng, Email: bisheng301@gmail.com

【**Abstract**】 **Objective**　To find the plantar pressure readings which best indicate foot inversion during the stance phase of walking among hemiplegic stroke survivors. **Methods**　Twenty-two hemiplegic stroke survivors who were able to walk without extra aid were recruited as the experimental group, while 17 healthy elderly men of similar age and body weight were selected as the control group. Those in both groups were asked to walk at their preferred speed over a Footscan device which measured medio-lateral pressure ratios, maximum plantar pressures and the contact areas of both feet. The Clinical Spasticity Index (CSI) was used to evaluate the affected feet. **Results**　The average medial forefoot pressure of the affected side in the experimental group was significantly lower than that of the control group, but their average mesopodium and heel pressure was significantly higher. The average pressure applied

DOI:10.3760/cma.j.issn.0254-1424.2015.09.006

作者单位:100853 北京,解放军总医院康复医学中心(胡楠、毕胜、卢茜、邓思宇、张佳玮);广州医科大学附属第二医院康复科(胡楠);首都医科大学附属北京康复医院康复诊疗中心(郄淑燕、刘畅)

通信作者:毕胜,bisheng301@gmail.com

by the great toe on the uninjured side in the experimental group was significantly smaller than that of the control group, but the average mesopodium and heel pressure of both feet among the hemiplegics were significantly higher than those of the control group. Among the experimental group, the average medial forefoot pressure of the affected foot was significantly greater than that of the healthy foot. The average contact area of the great toe on the affected side was significantly bigger than was observed in the control group. That of the medial forefoot was, however, significantly smaller than in the control group. There was no significant difference in the contact area between the healthy and affected feet in the experimental group, though the maxmium medio-lateral pressure ratios of their full feet and forefeet on the affected side were significantly lower than those in the healthy group. No significant differences in the maxmium medio-lateral pressure ratios of the heel were observed between the two groups, nor of the full feet, forefeet and heels of the affected and unaffected sides in the experimental group. The patients demonstrated consistently reduced joint mobility on both sides during the stance phase, coinciding with increased inversion. A significant negative correlation was found between the maxmium medio-lateral pressure ratios of the full foot and the maximum pressure of the lateral part of forefoot in the experimental group, but there was no significant correlation with contact area or CSI. **Conclusions** Plantar pressure data can be used to describe the amount of foot inversion in the stance phase of walking with hemiplegic patients after stroke. The maxmium medio-lateral pressure ratios can effectively reflect their foot inversion.

【**Key words**】 Hemiplegia; Stroke; Plantar pressure; Inversion; Gait

足内翻是脑卒中患者足部最常见的异常[1-4]，出现足内翻的原因包括下肢共同运动[5]，摆动期小腿三头肌、胫后肌、拇长伸肌、趾长伸肌、腓骨肌提前激活，胫前肌活动失常及趾长伸肌力弱[1]，支撑期胫前肌和小腿三头肌过度且不协调运动[6]。目前对足内翻的评估主要基于临床观察，缺乏客观、定量的指标。近年兴起的三维运动学分析，可通过描述患者行走时各关节的角度变化，准确全面地描述足内翻[7]，而此方法由于价格昂贵且操作复杂，并不能做到临床普及。足底压力测试，即使用压力板或压力鞋测量患者行走时足对地面的垂直作用力，能分析患者步态的动力学特征。目前已有文献证实了足底压力描述足内翻的可行性[8-10]，但罕见其用于分析脑卒中患者足内翻的报道[11]。本研究旨在探讨脑卒中偏瘫足内翻患者步行支撑期的足底压力特征。

资料与方法

一、研究对象

入选标准：①符合 1995 年全国第 4 届脑血管疾病学术会议制订的脑卒中诊断标准[12]，并经头颅 CT 或 MRI 证实；②患者首次发病，单个病灶；③病程大于 3 个月；④一侧肢体运动功能障碍；⑤能独立行走至少 30 m，简易精神状态检查（mini-mental state examination，MMSE）评分≥20 分。排除标准：①有脑干、小脑病变；②伴其他周围神经或中枢神经系统疾患；③有下肢活动性炎症和畸形；④有严重的视空间障碍。选取 2014 年 5 月至 2014 年 12 月在解放军总医院康复医学中心及北京康复医院治疗且符合上述标准的脑卒中患者 22 例设为病例组，另选与患者年龄、体重相匹配的中老年健康志愿者 17 例设为对照组。所有研究对象或家属知情并签署知情同意书。详见表 1。

表 1　2 组受试临床基本情况

组别	例数	性别（例）		平均年龄	平均身高	平均体重
		男	女	（岁，$\bar{x}\pm s$）	（cm，$\bar{x}\pm s$）	（kg，$\bar{x}\pm s$）
对照组	17	15	2	55.56±5.50	172.78±5.38	75.22±10.64
病例组	22	20	2	51.90±8.21	170.80±3.23	75.40±7.49

二、测试方法

测试时，患者无辅助，光脚以舒适步速来回行走在 10 m 长的走道上，走道中间嵌有压力板（1.00 m × 0.42 m，100 Hz，Footscan）。采集双足各 3 次的动态足底压力，记录并分析患者行走时的足底压强和接触面积。

软件自动将足底分为 10 个区（见图 1）：第 1 趾（Toe 1，T_1）、第 2～5 趾（Toe 2-5，$T_{2\text{-}5}$）、第 1 跖骨（Metatarsal 1，M_1）、第 2 跖骨（Metatarsal 2，M_2）、第 3 跖骨（Metatarsal 3，M_3）、第 4 跖骨（Metatarsal 4，M_4）、第 5 跖骨（Metatarsal 5，M_5）、中足（Midfoot，MF）、足跟内侧（Heel medial，HM）、足跟外侧（Heel lateral，HL）。并可测得其最大压强（单位：N/m^2）及接触面积（单位：m^2）。

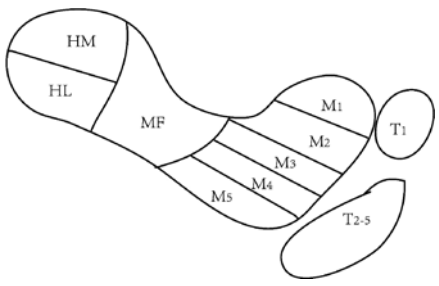

图 1　足底 10 个区示意图

参照上述分区，将足底合并为 5 个部分：第 1 趾（T_1）、第 2～5 趾（$T_{2\text{-}5}$）、前足内侧（包括 M_1、M_2）、前足

外侧(包括 M_3、M_4、M_5)、中足及足跟(包括 MF、HM、HL)。并将 10 个区域的最大压强、接触面积按照 5 个分区相加而合并。

由于所有受试者的数据并非在同一时间采集,且每次采集前均需根据实际情况进行校准,所以本研究所呈现的数据均为某个区域参数相对于所有分区对应参数之和的百分比。由于足底压力受体重的影响,因此本研究对数据表格中的压强值均进行了除以患者体重的标准化处理。

根据足底压力的分布规律,可描述患者足内翻的情况,使用足内外侧压强比值,即足内侧压强与外侧压强的差除以全足压强[10]:①全足内外侧压强比值 = $[(M_1 + M_2 + HM) - (M_3 + M_4 + M_5 + HL)]/(T_1 + T_{2\text{-}5} + M_1 + M_2 + M_3 + M_4 + M_5 + MF + HM + HL)$;②前足内外侧压强比值 = $[(M_1 + M_2) - (M_3 + M_4 + M_5)]/(T_1 + T_{2\text{-}5} + M_1 + M_2 + M_3 + M_4 + M_5 + MF + HM + HL)$;③足跟内外侧压强比值 = $(HM - HL)/(T_1 + T_{2\text{-}5} + M_1 + M_2 + M_3 + M_4 + M_5 + MF + HM + HL)$ 最大值指整个支撑期,全足、前足、足跟各自的内外侧压强比值的最大值;均数指整个支撑期,全足、前足、足跟各自的内外侧压强比值的均数。取整个足支撑期足内外侧压强比值的最大值,比较健康人优势侧与患者健患足的内翻情况。足内外侧压强比值越小,足内翻越明显。

使用临床痉挛指数(clinical spasticity index, CSI)[13-14]评价脑卒中偏瘫患者的痉挛情况。CSI 的下肢部分通过测量患者一侧的跟腱反射、踝阵挛和小腿三头肌张力三个方面来评价下肢痉挛程度,即 0 ~ 9 分为轻度痉挛,10 ~ 12 分为中度痉挛,13 ~ 16 分为重度痉挛。

三、统计学方法

使用 SPSS 17.0 版统计学软件进行数据统计学分析处理,所得数据以($\bar{x} \pm s$)表示,组间均数比较采用独立样本 t 检验,组内均数比较采用配对样本 t 检验;相关性采用 Pearson 相关分析,计算足内外侧压强比值与足底各区接触面积、压强、CSI 之间的相关性。$P < 0.05$ 认为差异有统计学意义。

结　果

一、各区域压强比较

病例组患侧前足内侧压强小于对照组优势侧,中足及足跟压强大于对照组优势侧,且组间差异均有统计学意义($P < 0.05$)。病例组健侧第 1 趾压强小于对照组优势侧,中足及足跟压强大于对照组优势侧,组间差异均有统计学意义($P < 0.05$)。病例组患者患侧前足外侧压强大于组内患者健侧,且差异有统计学意义($P < 0.05$)。具体数据见表 2。

二、各区域接触面积比较

病例组患侧第 1 趾接触面积大于对照组优势侧,前足内侧接触面积小于对照组优势侧,且组间差异有统计学意义($P < 0.05$)。病例组各区域健患侧比较,差异无统计学意义($P > 0.05$)。具体数据见表 3。

三、足内外侧压强比值

病例组患侧与对照组优势侧相比,患侧足内外侧压强比值的最大值明显小于对照组优势侧,且全足和前足的足内外侧压强比值的最大值组间比较,差异有统计学意义($P < 0.05$);而足跟的足内外侧压强比值的最大值组间比较,差异无统计学意义($P > 0.05$)。病例组健侧与对照组优势侧相比,全足、前足及足跟的足内外侧压强比值最大值组间比较,差异无统计学意义($P > 0.05$)。病例组健侧与患侧全足、前足及足跟的足内外侧压强比值最大值比较,差异均无统计学意义($P > 0.05$);但有患侧小于对照组优势侧,患侧小于健侧的趋势($P > 0.05$)。具体数据见表 4。

表 2 对照组健康人和病例组患者足底各区域压强占所有分区之和的百分比(%,$\bar{x} \pm s$)

组别	例数	足底各区域				
		第 1 趾	第 2 ~ 5 趾	前足内侧	前足外侧	中足及足跟
对照组优势侧	17	14.84 ± 6.54	5.04 ± 3.60	29.82 ± 7.45	37.47 ± 12.60	25.05 ± 4.92
病例组						
患侧	22	11.64 ± 10.28	3.70 ± 2.99	23.52 ± 10.15[a]	45.45 ± 17.71[b]	38.17 ± 13.57[a]
健侧	22	9.04 ± 7.47[a]	3.23 ± 3.02	24.39 ± 15.21	37.04 ± 22.09	49.61 ± 26.36[a]

注:与对照组优势侧比较,[a]$P < 0.05$;与病例组健侧比较,[b]$P < 0.05$

表 3 对照组健康人和病例组患者足底各区域接触面积占全足的百分比(%,$\bar{x} \pm s$)

组别	例数	足底各区域				
		第 1 趾	第 2 ~ 5 趾	前足内侧	前足外侧	中足及足跟
对照组优势侧	17	8.57 ± 1.17	8.43 ± 1.62	17.62 ± 1.52	19.10 ± 1.10	4.62 ± 1.86
病例组						
患侧	22	9.96 ± 1.67[a]	7.63 ± 2.65	14.71 ± 4.64[a]	18.08 ± 4.76	45.88 ± 1.11
健侧	22	9.14 ± 1.86	7.96 ± 3.35	16.22 ± 4.58	17.76 ± 4.44	45.15 ± 10.93

注:与对照组优势侧比较,[a]$P < 0.05$

表 4　对照组健康人和病例组患者足内外侧压强比值的比较($\bar{x} \pm s$)

组别	例数	全足		前足		足跟	
		最大值	均数	最大值	均值	最大值	均值
对照组优势侧	17	43.68 ± 23.78	−2.44 ± 13.87	41.09 ± 28.13	−7.40 ± 11.16	27.25 ± 11.97	4.97 ± 3.50
病例组							
患侧	22	27.27 ± 22.73[a]	−6.98 ± 10.58	22.81 ± 22.19[a]	−9.71 ± 10.20	23.41 ± 14.96	2.90 ± 7.71
健侧	22	38.83 ± 28.56	−0.37 ± 18.17	35.46 ± 28.11	−0.38 ± 18.10	35.84 ± 28.71	0.73 ± 17.48

注：与对照组优势侧比较，[a] $P < 0.05$

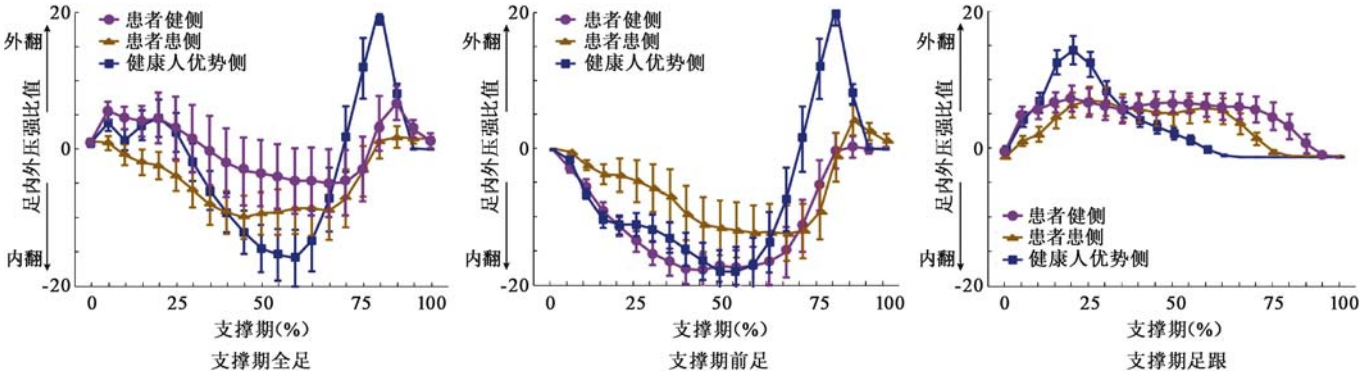

图 2　足内外侧压强比值随支撑期时间变化曲线图(曲线为均数，误差棒为标准误)

四、支撑期足内外侧压强比值随时间的变化

足内外侧压强比值在支撑期随时间的变化情况如图 2 所示。可见健康人全足在着地期呈轻度足外翻，推进期呈足内翻，离地期呈足外翻；前足在着地期和推进期内翻，离地时明显外翻；足跟在着地时外翻，在推进期恢复至中立位并离地。患者的健患足则翻转幅度减小，且整体呈足内翻，双侧足跟在支撑末期仍有受力。

五、临床痉挛指数

对 22 例患者进行了 CSI 评定，其中轻度痉挛 13 例，中度痉挛 5 例，重度痉挛 4 例。病例组患者患侧总体的踝关节 CSI 得分(10.26 ± 3.38)分，95% 可信区间位于 8.63 ~ 11.89。

六、足内外侧压强比值与足底各区域接触面积、压强及 CSI 的相关性

病例组脑卒中患者的全足内外侧压强比值与前足外侧压强呈负相关($r = -0.516$，$P < 0.05$)，全足内外侧压强比值与患者足底各区域的接触面积无显著相关($P > 0.05$)；CSI 与患者足底各区域的接触面积及压强无显著相关($P > 0.05$)；全足内外侧压强比值与 CSI 无显著相关($P > 0.05$)。

讨　论

一、足底内外侧压强比值的最大值可定量反映脑卒中患者的足内翻程度

本研究中，病例组患者患侧前足内侧的接触面积和压强均小于对照组优势侧，而患侧前足外侧压强大于健侧足(详见表 2 和表 3)，提示患足内侧受力减小、外侧受力增大，支持患侧足内翻[15]；病例组患者双侧的中足及足跟压强均大于对照组优势侧(详见表 2)，提示患者踝关节不稳，患有足内翻[8]；病例组患者健侧足与患侧足之间的内外侧压强比值、接触面积和除前足外侧以外的各足底区域的压强比较，差异均无统计学意义($P > 0.05$)，这可能与参与本研究的患者痉挛程度较轻、步行功能较好有关。从脑卒中恢复的中枢机制来看，下肢运动冲动由网状脊髓束、前庭脊髓束和红核脊髓束传导[21-22]，当脑卒中损伤一侧大脑半球后，常表现为偏瘫，患者的患侧下肢出现异常后，机体为适应其不对称性，而发生中枢水平的恢复[17-18,23]和健侧下肢的代偿机制[19-20]。因此脑卒中偏瘫患者的健侧也并非完全正常。

另外，足内翻是脑卒中患者步态的特征性表现，在使用足底压强来定量描述卒中患者的足内翻时，本研究选择了足内外侧压强比值这一指标。Willems 等[10]于 2005 年提出足内外侧压强比值，并在 223 例健康青年人中得到验证；足内外侧压强比值越小，内翻程度越大。

病例组患侧全足及前足处的足内外侧压强比值的最大值减小，且与对照组优势侧相比，差异有统计学意义($P < 0.05$)；患侧足跟的足内外侧压强比值的最大值虽与健康人相比，差异无统计学意义($P > 0.05$)，但亦有减小的趋势(详见表 4)。这说明病例组支撑期患侧足外侧受力较内侧大，尤其是前外侧足负重更大，即呈足内翻姿势。

这与既往通过其它方法所观察到的脑卒中偏瘫患者足内翻[15-16]的特征一致，但这些研究缺乏统一且专门用来描述足内翻这一异常特征的指标，因此不便于临床应用。本研究使用的足内外侧压强比值能给临床工作者提供一个指数来衡量足内翻的程度，这更有利

于临床评估。

二、支撑期足内外侧压强比值随时间的变化呈现一定规律

支撑期足内外侧压强比值随时间的变化呈现一定规律,本研究发现,对照组健康人全足轻度外翻着地,随后足内翻,离地时再次呈外翻;前足在着地期和推进期内翻程度逐渐加大,离地时则明显外翻;足跟外翻着地,之后外翻角度逐渐减小并蹬离地面。而患者的健患侧全足、前足、中足及足跟翻转幅度减小,且整体表现为足内翻,足跟在支撑期末期仍有受力,提示脑卒中偏瘫患者足跟离地困难。

本研究中,健康中老年人全足、前足及足跟支撑期的内外翻规律与 Morrison 等[9] 和 Willems 等[10] 的研究结论一致,即支撑期后足内翻,前足外翻;对于脑卒中患者全足、前足及足跟的异常运动,目前研究多是关注其踝跖屈及背屈问题[24],对于其内外翻的规律却罕见报道。Forghany 等[25] 通过分析前中后及全足多关节的角度变化,发现支撑期足的运动幅度减小,前中后足及全足在矢状面的内外翻情况与健康人相比无显著差异。本研究通过足内外侧压强比值显示脑卒中患者全足、前足明显内翻,足跟有内翻趋势,且足跟表现出离地困难。本实验结果与既往研究不符的可能原因:①健康人与患者步速的差异会影响踝关节的运动[26];②造成脑卒中患者足底压强异常的原因不仅只有足内翻,还包括足下垂、旋前等[24-25]。在未来的研究中,可统一健康人与患者的步行速度,并结合三维运动学分析来进一步明确患者各部分足随步态周期变化的规律及其与足底压强特征的联系。

三、足内外侧压强比值的最大值与足底压强和接触面积存在相关性

脑卒中偏瘫患者支撑期的足内翻与小腿肌群的不协调运动及胫前肌、小腿三头肌的痉挛有关[1,6]。CSI 下肢部分通过测量患者患侧的跟腱反射、踝阵挛、小腿三头肌张力,能全面地评价患者痉挛情况[13-14]。全足内外侧压强比值的最大值与 CSI 无相关,这说明足内外侧压强比值的最大值不能反映卒中患者的痉挛程度。

全足内外侧压强比值的最大值与前足外侧压强呈负相关,即足内外侧压强比值的最大值越小,足内翻程度越大,前足外侧的压强越大。这正好符合足内翻的足底受力特征[3,15],进一步证明了全足内外侧压强比值能够反映脑卒中偏瘫者的足内翻情况。

综上所述,足内外侧压强比值的最大值是反映脑卒中偏瘫患者足内翻的有效指标,其测量简便,具有很好的临床应用价值。本研究已通过足内外侧压强比值的最大值发现了脑卒中偏瘫患者足内翻的趋势,验证了足内外侧压强比值的最大值用以评价脑卒中患者足内翻的可行性。本研究的不足在于,未结合三维运动学分析,证实足内外侧压强比值的最大值在评价脑卒中偏瘫患者足内翻中的可靠性。今后研究需结合足底压力学其它指标(如压强中心)以及三维运动学分析方法等,来共同探讨脑卒中偏瘫患者足内翻的评估标准。

参 考 文 献

[1] Reynard F, Deriaz O, Bergeau J. Foot varus in stroke patients: muscular activity of extensor digitorum longus during the swing phase of gait [J]. Foot, 2009, 19(2): 69-74.

[2] Lamontagne A, Stephenson JL, Fung J. Physiological evaluation of gait disturbances post stroke[J]. Clin Neurophysiol, 2007, 118(4): 717-729.

[3] 励建安. 脑卒中的步态异常和治疗对策[J]. 中华全科医师杂志, 2005(12): 715-717.

[4] Harkless LB, Bembo GP. Stroke and its manifestations in the foot. A case report[J]. Clin Podiatr Med Surg, 1994, 11(4): 635-645.

[5] 王桂茂, 齐瑞, 严隽陶. 中风偏瘫步态的生物力学及其运动学特征分析[J]. 中国组织工程研究与临床康复, 2007, 11(40): 8169-8172.

[6] 瓮长水. 脑卒中患者步行功能障碍评价[J]. 中国临床康复, 2002, 13(6): 1869-1871.

[7] Forghany S, Nester CJ, Tyson SF, et al. The effect of stroke on foot kinematics and the functional consequences[J]. Gait Posture, 2014, 39(4): 1051-1056.

[8] Rice H, Nunns M, House C, et al. High medial plantar pressures during barefoot running are associated with increased risk of ankle inversion injury in Royal Marine recruits[J]. Gait Posture, 2013, 38(4): 614-618.

[9] Morrison KE, Hudson DJ, Davis IS, et al. Plantar pressure during running in subjects with chronic ankle instability[J]. Foot Ankle Int, 2010, 31(11): 994-1000.

[10] Willems T, Witvrouw E, Delbaere K, et al. Relationship between gait biomechanics and inversion sprains: a prospective study of risk factors [J]. Gait Posture, 2005, 21(4): 379-387.

[11] 曹娟娟, 夏清, 袁海, 等. 脑卒中偏瘫患者足内翻的足底压力分布研究[J]. 中华脑科疾病与康复杂志(电子版), 2015, 5(1): 21-25.

[12] 中华神经科学会, 中华神经外科学会. 各类脑血管疾病诊断要点[J]. 中华神经科杂志, 1996, 29(6): 379-380.

[13] 燕铁斌. 临床痉挛指数: 痉挛的综合临床评定[J]. 现代康复, 2000, 4(01): 88-89.

[14] Levin MF, Hui-Chan C. Are H and stretch reflexes in hemiparesis reproducible and correlated with spasticity[J]. J Neurol, 1993, 240(2): 63-71.

[15] Hillier S, Lai MS. Insole plantar pressure measurement during quiet stance post stroke[J]. Top Stroke Rehabil, 2009, 16(3): 189-195.

[16] Perry J, Garrett M, Gronley JK, et al. Classification of walking handicap in the stroke population[J]. Stroke, 1995, 26(6): 982-989.

[17] Kim YH, You SH, Kwon YH, et al. Longitudinal fMRI study for locomotor recovery in patients with stroke[J]. Neurology, 2006, 67(2): 330-333.

[18] Miyai I, Yagura H, Hatakenaka M, et al. Longitudinal optical imaging study for locomotor recovery after stroke[J]. Stroke, 2003, 34(12):

2866-2870.
[19] Balaban B, Tok F. Gait disturbances in patients with stroke[J]. PM R, 2014, 6(7): 635-642.
[20] Chisholm AE, Perry SD, Mcilroy WE. Inter-limb centre of pressure symmetry during gait among stroke survivors[J]. Gait Posture, 2011, 33(2): 238-243.
[21] Duus P. Duus 神经系统疾病定位诊断学: 解剖生理临床[M]. 刘宗惠, 徐霓霓, 译. 8 版. 北京: 海洋出版社, 2006: 48-56.
[22] Jang SH. The recovery of walking in stroke patients: a review[J]. Int J Rehabil Res, 2010, 33(4): 285-289.
[23] Coscia M, Monaco V, Martelloni C, et al. Muscle synergies and spinal maps are sensitive to the asymmetry induced by a unilateral stroke[J]. J Neuroeng Rehabil, 2015, 12(1): 1-16.
[24] Bensoussan L, Mesure S, Viton JM, et al. Kinematic and kinetic asymmetries in hemiplegic patients' gait initiation patterns[J]. J Rehabil Med, 2006, 38(5): 287-294.
[25] Forghany S, Nester CJ, Tyson SF, et al. The effect of stroke on foot kinematics and the functional consequences[J]. Gait Posture, 2014, 39(4): 1051-1056.
[26] Hanlon M, Anderson R. Prediction methods to account for the effect of gait speed on lower limb angular kinematics[J]. Gait Posture, 2006, 24(3): 280-287.

(修回日期: 2015-07-13)
(本文编辑: 汪 玲)

· 外刊撷英 ·

Plantar fasciitis treated with polydeoxyribonucleotide

BACKGROUND AND OBJECTIVE Plantar fasciitis is a common cause of heel pain, and is a frequent complaint of athletes. As polydeoxyribonucleotide (PDRN) has been found to have anti-inflammatory and immune modulating properties, this study was designed to measure the efficacy of PDRN injections as a treatment option.

METHODS This prospective, randomized study included 40 patients clinically diagnosed with plantar fasciitis. The subjects were randomized to receive either a PDRN or a placebo injection. All participants were assessed at baseline and at four and 12 weeks' follow-up using a visual analogue scale (VAS) for pain, and the Manchester-Oxford Foot Questionnaire (MOXFQ).

RESULTS At four weeks, the treatment group had achieved significant improvement on both the VAS and MOXFQ, with that improvement continuing until 12 weeks. No significant improvement was seen in the placebo group. At four weeks' follow-up, the VAS average score of the treatment group was 4.7 and of the placebo group 5.9 ($P=0.06$), while, at 12 weeks, the average VAS of the treatment group was 3.7, and of the placebo group was 6.3 ($P<0.001$). Similar results were found on the MOXFQ, with significant differences evolving at 12 weeks, as compared with the placebo group ($P<0.001$).

CONCLUSION This prospective, blinded study of patients with chronic plantar fasciitis found that a polydeoxyribonucleotide injection can improve pain and outcome.

【摘自: Kim JK, Chung JY. Effectiveness of polydeoxyribonucleotide injection versus normal saline injection for treatment of chronic plantar fasciitis: a prospective, randomized, clinical trial. Intern Ortho, 2015, 39(7): 1329-1334.】

Neuromodulation for acute brain injury

BACKGROUND AND OBJECTIVE In recent years, neuromodulation has been of increasing interest as a treatment regimen to increase brain activity after stroke. However, few studies have focused on its effects after traumatic brain injury (TBI). This animal study assessed the effects of epidural electrical stimulation (EES) and repetitive transcranial magnetic stimulation (rTMS) on recovery of motor function and brain activity after TBI.

METHODS This trial included 30, male Sprague Dawley rats which were initially trained in a single pellet reaching task (SPRT) and the rotarod task (RRT). The animals were then subjected to a cortical impact and a fluid percussion brain injury. They were then randomly assigned to receive EES, rTMS or sham treatment for 14 days after injury. The animals were then retested with the SPRT and the RRT. At two weeks, the animals were euthanized for histopathologic examination.

RESULTS The success rates on the SPRT and the RRT were significant higher in the EES group than in the sham group ($P<0.05$ for both comparisons). In the EES group, SPRT success was significantly higher than in the sham group on postoperative days eight through 12 ($P<0.05$). In the rTMS group, the improvement in the SPRT success rate was significantly higher between postoperative days four and 14 ($P<0.05$). Performance on the RRT did not differ significantly between the three groups on postoperative day 14. Immunohistochemical staining revealed that the expression of C-Fos (a measure of plasticity) was lower in the sham group than in either treatment group, as well as in the non-stimulated side of the EES group as compared with the stimulated side.

CONCLUSION This animal study found that transcranial magnetic stimulation, as well as epidural electrical stimulation, can be used to enhance motor recovery and brain activity after brain injury.

【摘自: Yoon YS, Cho KH, Kim ES, et al. Effect of epidural electrical stimulation and repetitive transcranial magnetic stimulation in rats with diffuse traumatic brain injury. Annals of Rehab Med, 2015, 39(3): 416-424.】