镜像疗法联合功能性电刺激治疗脑卒中患者上肢运动功能障碍临床研究

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摘要　**目的：**观察镜像疗法（MT）联合功能性电刺激（FES）对脑卒中患者上肢运动功能障碍和鱼际肌萎缩的影响。**方法：**选择2017年8月—2020年8月邢台市第三医院康复医学科收治的120例脑卒中后上肢运动功能障碍患者，采用随机数字表法分为对照组和观察组，每组60例。2组均接受常规药物治疗和常规康复训练。对照组在常规治疗基础上接受FES疗法，观察组在对照组基础上接受MT疗法。分别于治疗前后采用Fugle-Meyer运动功能评定量表上肢部分（FMA-UE）、Wolf上肢运动功能评价量表（WMFT）、Brunnstrom偏瘫分级评定量表评定患者上肢运动功能；采用功能独立性评定量表（FIM）评定患者功能独立性；采用改良Barthel指数（MBI）评定患者日常生活活动能力；采用彩色超声诊断仪测量鱼际肌群横截面积（CSA）和周长。**结果：**① 上肢运动功能：与治疗前比较，2组治疗后FMA-UE、WMFT和Brunnstrom偏瘫分级评分均明显提高，差异均具有统计学意义（$P<0.05$）；与对照组比较，观察组治疗后FMA-UE、WMFT和Brunnstrom偏瘫分级评分均明显更高，差异均具有统计学意义（$P<0.05$）。② FIM、MBI评分：与治疗前比较，2组治疗后FIM、MBI评分均明显提高，差异均具有统计学意义（$P<0.05$）；与对照组比较，观察组治疗后FIM、MBI评分均明显更高，差异均具有统计学意义（$P<0.05$）。③ 鱼际肌群CSA、周长：与治疗前比较，2组治疗后鱼际肌肌群CSA、周长均明显升高（$P<0.05$）。与对照组比较，观察组治疗后鱼际肌肌群CSA、周长均明显更高，差异均具有统计学意义（$P<0.05$）。**结论：**MT联合FES可以有效改善脑卒中患者上肢运动功能，减少鱼际肌萎缩程度，提高患者日常生活活动能力。

关键词　脑卒中；上肢运动功能障碍；功能性电刺激；镜像疗法；日常生活活动能力；鱼际肌

脑卒中是由于脑部血液供应中断或血管破裂而引起的脑组织损伤，主要包括缺血性脑卒中和出血性脑卒中，其中缺血性脑卒中最常见，约占所有脑卒中病例的80%～85%[1]。上肢运动功能障碍是脑卒中患者的常见并发症之一，约75%脑卒中患者会出现一定程度的上肢运动功能障碍，严重影响患者生活质量[2]。由于手在大脑皮质的投射区域较大，且手及手指精细动作以及协调配合程度较为复杂，上肢和手功能恢复难度较大，仅3%脑卒中患者合并上肢运动功能障碍后能够恢复70%以上[3]。目前传统的手功能康复手段[如冷疗、功能性电刺激（functional electrical stimulation，FES）、运动疗法和作业疗法以及中医康复等]虽有一定疗效，但往往耗费较多人力，康复过程较为单调，缺少调动患者主动参与的刺激与反馈，康复效果不够理想[4]。镜像疗法（mirror therapy，MT）是一种基于视觉反馈、视错觉的康复训练手段，利用患者自身健侧活动在平面镜中成像刺激其患侧运动，从而激活大脑镜像

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神经元系统，调动大脑运动神经系统的主动参与，康复训练过程简单，在脑卒中偏瘫患者运动康复应用较为广泛[5]，MT可一定程度弥补FES疗法的不足。本研究采用MT联合FES治疗脑卒中后上肢运动功能障碍患者，取得良好疗效。

1 临床资料

1.1 病例选择标准

1.1.1 诊断标准 符合《中国各类主要脑血管疾病诊断要点2019》[6]有关脑卒中的诊断标准，并经CT/MRI确诊。

1.1.2 纳入标准 ① 首次发病；② 病程＜3个月；③ 年龄＞18周岁；④ 仅一侧肢体表现出功能障碍，手部和上肢偏瘫Brunnstrom分级均为Ⅰ～Ⅳ级；⑤ 无支撑自主端坐位能够坚持20 min；⑥ 患者及其家属知情同意，并自愿签署知情同意书。

1.1.3 排除标准 ① 存在言语听理解障碍；② 存在其他脑器质性病变；③ 患侧上肢或手改良Ashworth痉挛≥2级；④ 健侧上肢残疾或患有其他导致严重疼痛感的疾病；⑤ 心、肺等重要脏器病变或有严重深静脉血栓等疾病。

1.1.4 中止和脱落标准 ① 患者依从性不强，不能完成治疗；② 治疗期间并发其他疾病、脑卒中复发等；③ 治疗期间，患者提前出院。

1.2 一般资料

选择2017年8月—2020年8月邢台市第三医院康复医学科收治的127例脑卒中后上肢运动功能障碍患者，采用随机数字表法分为对照组和观察组，分别为64、63例。治疗过程中，对照组及观察组分别有4、3例患者依从性不强、提前出院而脱落，最终每组纳入60例。2组性别、年龄、病程、偏瘫侧、脑卒中类型等一般资料比较，差异无统计学意义（$P>0.05$），具有可比性。见表1。本研究方案已通过邢台市第三医院医学伦理委员会审批（审批号：2017015-1）。

表1 两组患者一般资料比较

Table 1 Comparison of general data between two groups

组别	例数	性别		年龄/($\bar{x}\pm s$，岁)	病程/($\bar{x}\pm s$，d)	偏瘫侧		脑卒中类型	
		男	女			左	右	脑梗死	脑出血
对照组	60	34	26	54.74±3.85	7.62±1.14	24	36	41	19
观察组	60	30	30	53.75±4.54	7.94±1.27	31	29	38	22

2 方 法

2.1 治疗方法

2组患者均接受脑卒中相关基础药物联合常规康复训练。

2.1.1 对照组 对照组患侧上肢在常规疗法基础上接受FES治疗。采用表面肌电刺激器（上海诺诚电气股份有限公司，型号：MyoNet-BOW-Ⅲ）进行FES治疗。刺激电极片贴在患者患侧的腕伸肌、指伸肌的肌腹处，采集电极片放在刺激电极片旁边的相应部位。FES电刺激的参数如下：对称双相电流脉冲，频率、脉宽分别设置为40 Hz、250 μs；电流强度0～90 mA，具体根据引起患者所需功能性动作以及出现明显肌肉收缩进行调整，以患者可以耐受为度；速度设置为15～55 r/min，扭矩1～2 N·m，波形类型为脉冲、连续；脉冲频率为10～100 Hz，脉冲宽度50～500 μs。1次/d，30 min/次，5次/周，连续治疗4周。

2.1.2 观察组 在对照组基础上接受MT治疗。患者坐于治疗台前，并将镜盒置于治疗台上，患者将健侧上肢置于镜子反光面侧，将患侧上肢置于镜盒内，使得健侧在镜子中的成像与患侧重合；嘱患者观察镜子中的成像，同时治疗师指导患者双上肢做相同的动作或任务，利用视错觉“欺骗”大脑是患侧上肢在活动，并通过视觉想象使患者感觉到患肢与健肢在进行相同的动作。1次/d，20～30 min/次，5次/周，连续治疗4周。

2.2 观察指标

2.2.1 上肢运动功能评分 分别于治疗前后采用Fugle-Meyer运动功能评定量表上肢部分（Fugl-Meyer assessment of upper extremity，FMA-UE）[7]、Wolf上肢运动功能评价量表（Wolf motor function test，WMFT）[8]、Brunnstrom偏瘫分级评定量表评定患者上肢运动功能。

2.2.1.1 FMA-UE评分 采用FMA-UE评分评定患者上肢运动功能，FMA-UE评分越高表示患者上肢功能越好。

2.2.1.2 WMFT评分 采用WMFT评分评定患者上肢运动功能，该量表共15个项目，每项为0～5分，

总分75分。① 0分:患侧上肢未能参与测试;② 1分:患侧上肢试图参与测试,但没有产生功能性动作;③ 2分:患侧上肢成功参与测试,但仍需对位置进行稍微调整,或尝试2次及以上才完成测试;④ 3分:患侧上肢成功参与测试,但完成动作过程费时费力;⑤ 4分:患侧上肢成功参与测试,动作虽接近正常,但缺乏精准、协调和流畅,速度较健侧慢;⑥ 5分:受试上肢完成评定任务,与健侧相比动作无异常。

2.2.1.3 Brunnstrom偏瘫分级　采用Brunnstrom偏瘫分级评定量表评估患者上肢和手的肌张力及运动模式,该量表共分为Ⅰ～Ⅵ级。分级越高,表明患者上肢运动功能越好。Ⅰ～Ⅵ级分别对应1～5分。

2.2.2 功能独立性　采用功能独立性评定(functional independence measure,FIM)量表[9]评定患者功能独立性。主要包括自理能力、括约肌控制、转移、行走以及社会认知功能等13项,每项评分1～7分,总分为91分。分值越高,表示患者功能恢复越好。

2.2.3 日常生活活动能力　采用改良Barthel指数(modified Barthel index,MBI)量表[10]评定患者日常生活活动能力。① 完全依赖:0～20分;② 严重依赖:21～61分;③ 中度依赖:62～90分;④ 轻度依赖:91～99分;⑤ 独立:100分。

2.2.4 鱼际肌群横截面积　采用彩色超声诊断仪(美国通用电气公司,型号:LOGIO E9型)测量鱼际肌群横截面积(cross sectional area,CSA)。手部鱼际肌肌群包括拇短屈肌、拇短展肌、拇对掌肌以及拇收肌,测量时取距腕横纹1.5 cm处的CSA以及周长,测量3次,取平均值作为最终测量值。

2.3 统计学方法

采用SPSS 24.0统计软件进行数据分析。计量资料服从正态分布,数据以($\bar{x}\pm s$)表示,组内治疗前后比较采用配对t检验,组间比较采用两独立样本t检验;计量资料不服从正态分布,数据以$M(P_{25},P_{75})$表示,组间比较采用Wilcoxon检验。计数资料采用频数表示,组间比较采用χ^2检验。$P<0.05$为差异具有统计学意义。

3 结　果

3.1 2组治疗前后FMA-UE、WMFT和Brunnstrom偏瘫分级评分比较

与治疗前比较,2组治疗后FMA-UE、WMFT和Brunnstrom偏瘫分级评分均明显提高,差异均具有统计学意义($P<0.05$);与对照组比较,观察组治疗后FMA-UE、WMFT和Brunnstrom偏瘫分级评分均明显更高,差异均具有统计学意义($P<0.05$)。见表2。

表2　2组治疗前后FMA-UE、WMFT和Brunnstrom偏瘫分级评分比较($\bar{x}\pm s$)/[$M(P_{25},P_{75})$]　分

Table 2　Comparison of FMA-UE, WMFT and Brunnstrom hemiplegia grading scores between two groups before and after treatment ($\bar{x}\pm s$)/[$M(P_{25},P_{75})$]　Scores

组别	例数	FMA-UE评分		WMFT评分		Brunnstrom偏瘫分级评分	
		治疗前	治疗后	治疗前	治疗后	治疗前	治疗后
对照组	60	9.0(4.0,19.0)	12.5(7.0,21.0)[1)]	7.0(2.0,21.0)	12.0(4.6,22.0)[1)]	2.04±0.58	2.98±0.65[1)]
观察组	60	8.5(3.0,18.0)	23.0(12.0,46.0)[1)2)]	6.8(3.0,18.0)	18.0(5.1,31.0)[1)2)]	2.12±0.69	3.67±1.02[1)2)]

注:与治疗前比较,1) $P<0.05$;与对照组比较,2) $P<0.05$。

Note: Compared with that before treatment, 1) $P<0.05$; compared with the control group, 2) $P<0.05$.

3.2 2组FIM、MBI评分比较

与治疗前比较,2组治疗后FIM、MBI评分均明显提高,差异均具有统计学意义($P<0.05$)。与对照组比较,观察组治疗后FIM、MBI评分均明显更高,差异均具有统计学意义($P<0.05$)。见表3。

表3　2组治疗前后FIM、MBI评分比较($\bar{x}\pm s$)　分

Table 3　Comparison of FIM and MBI scores between two groups before and after treatment ($\bar{x}\pm s$)　Scores

组别	例数	FIM评分		MBI评分	
		治疗前	治疗后	治疗前	治疗后
对照组	60	65.52±3.85	70.52±4.01[1)]	44.69±8.02	55.57±9.65[1)]
观察组	60	64.89±3.71	78.96±4.88[1)2)]	45.41±8.40	67.54±10.17[1)2)]

注:与治疗前比较,1) $P<0.05$;与对照组比较,2) $P<0.05$。

Note: Compared with that before treatment, 1) $P<0.05$; compared with the control group, 2) $P<0.05$.

3.3 2组治疗前后鱼际肌群CSA比较

与治疗前比较，2组治疗后鱼际肌肌群CSA、周长均明显升高，差异均具有统计学意义（$P<0.05$）。与对照组比较，观察组治疗后鱼际肌肌群CSA、周长均明显更高，差异均具有统计学意义（$P<0.05$）。见表4。

表4 2组治疗前后鱼际肌肌群CSA和周长比较（$\bar{x}\pm s$）

Table 4 Comparison of CSA and perimeter of thenar muscle between two groups before and after treatment（$\bar{x}\pm s$）

组别	例数	CSA/cm^2		周长/cm	
		治疗前	治疗后	治疗前	治疗后
对照组	60	3.44±0.51	3.95±0.62[1)]	8.11±0.84	8.95±0.89[1)]
观察组	60	3.46±0.49	4.78±0.68[1)2)]	8.06±0.79	10.08±0.78[1)2)]

注：与治疗前比较，1）$P<0.05$；与对照组比较，2）$P<0.05$。

Note: Compared with that before treatment, 1) $P<0.05$; compared with the control group, 2) $P<0.05$.

4 讨 论

4.1 MT联合FES可有效改善脑卒中患者上肢运动功能

本研究结果显示，与对照组比较，观察组治疗后FMA-UE、WMFT和Brunnstrom偏瘫分级评分均明显更高，这提示MT联合FES可有效改善脑卒中患者上肢运动功能。这可能与以下因素有关：① 脑卒中会造成脑组织产生神经功能缺损，进而导致患者出现吞咽、语言障碍以及肢体偏瘫等后遗症，严重威胁患者生活能力和社会功能[11]。肢体偏瘫后实施康复训练可以有效改善患者肢体功能障碍程度，提高患者生活质量。FES将低频电流作用于失去神经支配的肌肉，通过不断的电流刺激以增强肌肉收缩功能，并使主动肌群和拮抗肌群的舒缩能力保持协调和平衡状态，进而整体改善患者肢体运动功能[12]。MT疗法作为一种视觉反馈疗法，通过让患者观察自身健侧肢体在镜子中的运动成像过程，促使大脑镜像神经元系统激活和恢复，以帮助改善患侧肢体运动能力，该康复治疗手段不需要特殊的仪器设备，且康复训练过程简单，不会产生不良反应[13]。② MT疗法可以通过视觉刺激调控机体大脑神经元，且该调控作用大大超过机体的触觉和本体感觉，当患者健侧上肢在镜中发生运动成像时，对侧大脑的相应功能控制区信号被激活处于活跃状态，并通过机体反馈机制进一步激活镜像神经元，从而有助于形成运动记忆区，进而促进患者平衡功能提升，减轻上肢运动障碍程度[14]。这与NOJIMA等[15]研究发现，MT疗法可提高受损肢体运动功能，促进主要运动皮质区重塑，通过视觉反馈激活主要运动皮质区，进而重启废用区域，改善皮质区兴奋性和电活动，促进运动功能恢复的结果相似。

4.2 MT联合FES可有效提高脑卒中患者日常生活活动能力

本研究结果显示，观察组治疗后FIM、MBI评分均明显更高，鱼际肌肌群CSA、周长均明显更高。这提示，MT联合FES可有效改善患者上肢运动的功能，提高日常生活活动能力，减少脑卒中患者鱼际肌萎缩程度。这可能与以下因素有关：① FES通过电流作用于脑卒中患者患侧肢体，使其产生功能性活动，扩大肩关节活动范围，减轻肩关节疼痛程度。此外，FES还可通过刺激拮抗肌的收缩交互抑制脑卒中患者患侧肢体主动肌痉挛的程度，或通过电流直接刺激痉挛肌肉，产生反射性地抑制主动肌痉挛，从而提高运动功能。② MT疗法能够对脑卒中患者病变区域神经细胞产生激活作用，促使更多正常神经细胞间建立联系，使大脑受损区域逐步由正常神经元承担，患侧部分运动通路得到易化，两大脑半球间抑制得以解除。此外，MT疗法还能提高脑卒中患者患侧肢体握力、前臂施后角度及肌肉厚度，从而改善脑卒中患者上肢运动功能以及吃饭、修饰、穿衣、转移、步行活动等日常生活活动能力。

5 小 结

MT联合FES可以改善脑卒中患者上肢运动功能障碍程度，降低鱼际肌萎缩程度，提高患者日常生活活动能力。但本研究仍存在一些不足之处，如MT疗法的介入时间、训练时间等尚未统一，病例数相对较少，未进行随访等。下一步研究将扩大样本量，加强出院后随访，并探讨MT疗法的最佳介入时间和训练时间等，以期为MT联合FES治疗脑卒中后上肢运动功能障碍提供参考依据。

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Clinical Study of Mirror Therapy Combined with Functional Electrical Stimulation for Upper Limb Motor Dysfunction in Patients with Stroke

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ABSTRACT **Objective:** To observe the effect of mirror therapy (MT) combined with functional electrical stimulation (FES) on upper limb motor dysfunction and thenar muscle atrophy in stroke patients. **Methods:** A total of 120 patients with upper limb motor dysfunction after stroke in the Xingtai Third Hospital from August 2017 to August 2020 were randomly divided into control group and observation group, with 60 cases in each group. Both groups received routine drug treatment and conventional rehabilitation training. The control group received FES therapy in addition to the conventional therapy, while the observation group received MT therapy in addition to the conventional therapy. Before and after treatment, Fugl-Meyer assessment of upper extremity (FMA-UE), Wolf motor function test (WMFT) and Brunnstrom hemiplegia stage were used to evaluate the motor function of upper limbs of patients with stroke; functional independence measure (FIM) was used to evaluate the functional independence; modified Barthel index (MBI) was used to assess the activities of daily living of patients; and color ultrasound diagnostic instrument was used to measure the cross sectional area (CSA) and circumference of thenar muscles. **Results:** (1) Motor function of upper limbs: compared with those before treatment, FMA-UE, WMFT and Brunnstrom hemiplegia stage scores of both groups after treatment significantly improved, and the differences were statistically significant (P<0.05); compared with the control group, FMA-UE, WMFT and Brunnstrom hemiplegia stage scores in the observation group after treatment were significantly higher, and the differences were statistically significant (P<0.05). (2) FIM and MBI scores: compared with those before treatment, the FIM and MBI scores of both groups after treatment significantly increased, and the differences were statistically significant (P<0.05); compared with the control group, the FIM and MBI scores of the observation group after treatment were significantly higher, and the differences were statistically significant (P<0.05). (3) CSA and circumference of thenar muscles: compared with those before treatment, CSA and circumference of thenar muscles of both groups after treatment significantly increased (P<0.05). Compared with the control group, the CSA and circumference of thenar muscles in the observation group after treatment were significantly higher, and the differences were statistically significant (P<0.05). **Conclusion:** MT combined with FES can effectively improve the upper limb motor function of stroke patients, reduce the degree of thenar muscle atrophy, and improve the activities of daily living of patients.
KEY WORDS stroke; upper limb motor dysfunction; functional electrical stimulation; mirror therapy; activities of daily living; thenar muscle
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Therapeutic Effect of Neuromuscular Joint Facilitation on Hemiplegic Patients with Cerebral Infarction

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ABSTRACT **Objective:** To explore the therapeutic effect of neuromuscular joint faciclitation (NJF) on the upper extremity muscle tone, upper limb and hand motor function, bed mobility and transfers in hemiplegic patients with cerebral infarction. **Methods:** A total of 136 patients with cerebral infarction treated in the Department of Neurology of the First Affiliated Hospital of Sun Yat-sen University from August 2017 to January 2019 were divided into control group and experimental group according to whether the treatment included the NJF technique, with 70 and 66 cases in each group, respectively. Both groups received conventional drug therapy for stroke. The control group received upper limb rehabilitation therapy in addition, including functional electrical stimulation, passive joint movement training and transfer ability training, and each training was 20 minutes a time, once a day, five days a week for a total of 10 days. The experimental group received NJF training plus the therapy given to the control group, including upper limb extension-adduction-internal rotation mode, upper limb flexion-abduction-external rotation mode, upper limb flexion-adduction-external rotation mode and upper limb extension-abduction-internal rotation mode, 60 minutes a time, with NJF training for 20 minutes, and the same training as the control group shortened to 40 minutes, once a day, five days a week for 10 days. Before and after the treatment, modified Ashworth scale (MAS) for spasticity was used to assess the muscle tone of the upper limbs; Brunnstrom staging was used to assess the motor function of the affected upper limb and hand; the assist level with transfer was used to assess the bed mobility (including turning over to the healthy side and turning over to the affected side). **Results:** (1) MAS score of upper limb and Brunnstrom score of upper limb and hand: compared with before treatment, the differences in MAS and Brunnstrom scores of the upper limb of the two groups after treatment were statistically significant (P<0.05) , and the difference of Brunnstrom score of hand in the experimental group after treatment was statistically significant (P<0.05). Compared with the control group, the improvement rate of MAS grading, upper limb and hand Brunstrom staging in the experimental group were significantly higher, and the differences were statistically significant (P<0.05). (2) Turning over in bed and transfer ability: compared with that before treatment, the difference in the score of turning over to the healthy side of both groups after treatment was statistically significant (P<0.05), while the difference of turning over to the affected side of the control group after treatment was statistically significant (P<0.05). Compared with the control group, the improvement rate of turning over to the healthy side of the experimental group was significantly higher, and the difference was statistically significant (P<0.05). **Conclusion:** NJF technique can reduce the high muscle tone of upper extremity, improve the upper extremity and hand motor function, and improve the bed mobility and transfers of hemiplegic patients with cerebral infarction.
KEY WORDS cerebral infarction; hemiplegia; neuromuscular joint faciclitation; muscle tone; motor dysfunction
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