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矫形鞋垫联合踝关节持续被动运动用于偏瘫型脑瘫患儿步态稳定性控制的临床研究*

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摘要 目的:探讨矫形鞋垫联合踝关节持续被动运动(CPM)用于偏瘫型脑瘫患儿姿势控制的临床价值。**方法:**选择 2016 年 6 月~2017 年 6 月在我院康复科就诊的 56 例偏瘫型脑瘫患儿,随机均分成两组。对照组患儿每日行物理治疗(PT)训练,每次共 30 分钟,每日一次,每周五次。治疗组患儿常规物理治疗训练同对照组,并同时运用足部生物力学矫形技术及踝关节 CPM 治疗,每次 15 分钟,角度恒定为 -45-45 度,每天一次。两组治疗疗程为三个月。治疗结束后,比较两组患儿的平衡能力总有效率、GMFM(E 功能区评分)、肢体运动功能、踝关节张力及踝关节活动范围的改善情况。**结果:**两组患儿平衡能力总有效率(显效率与有效率之和)分别为 92.9%和 67.9%,治疗组明显优于对照组($P<0.05$)。治疗组治疗后 GMFM(E 功能区评分比较)明显高于对照组($P<0.01$),患侧肢体运动功能改善、踝关节张力、踝关节活动范围改善情况均明显优于对照组($P<0.05$)。**结论:**矫形鞋垫联合踝关节 CPM 明显有助于偏瘫型脑瘫患儿姿势控制的治疗。

关键词:小儿脑瘫;偏瘫;矫形鞋垫;踝关节持续被动运动;姿势控制

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A Clinical Study on the Gait Stability Control of Orthopedic Insole Combined with Ankle Joint CPM in Children with Hemiplegic Cerebral Palsy*

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ABSTRACT Objective: To explore the clinical value of orthopedic insole combined with continuous passive movement of ankle joint (CPM) for postural control of children with hemiplegic cerebral palsy. **Methods:** Choose 48 cases of hemiplegic cerebral palsy rehabilitation clinic of our hospital from June 2016 to June 2017, randomly divided into two groups. The children in the control group were trained with physical therapy (PT) every day, 30 minutes a day, once a day, five times a week. The children in the treatment group were treated with conventional physical therapy training as compared with the control group. At the same time, the foot biomechanics correction technique and CPM treatment of ankle joint were used at the same time, 15 minutes each time, the angle constant was -45 - 45 degrees, once a day. The two groups were treated for three months. After treatment, the total effective rate of children's balance ability, GMFM (E functional area score), limb motor function, ankle tension and ankle range of motion were compared between the two groups. **Results:** The total effective rate of balance in the two groups was 92.9% and 67.9 % respectively, and the treatment group was significantly better than the control group ($P<0.05$). After treatment, the GMFM (E functional area score) in the treatment group was significantly higher than that in the control group ($P<0.01$), and the improvement of motor function, ankle tension and ankle range of motion in the affected side were significantly better than those in the control group ($P<0.05$). **Conclusion:** Orthopedic insole combined with ankle CPM can be helpful for the treatment of postural control in children with hemiplegic cerebral palsy.

Key words: Children's cerebral palsy; Hemiplegia; Orthopedic insole; Ankle CPM; Posture control

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脑性瘫痪被定义为自受孕开始至婴儿期非进行性脑损伤和发育缺陷所导致的综合征,主要表现为运动障碍及姿势异常^[1]。儿童成熟的步态控制及稳定的姿势控制能力对日后执行日常活动非常重要,但对于脑瘫患儿而言,维持日常功能的稳定姿势并执行特定的运动却是一项非常高难度的挑战^[2]。对于偏瘫型脑瘫患儿,步行时常常更多的表现为划圈步态,伴随偏

瘫侧经常会有足弓塌陷、足内翻、足外翻等异常姿势,平衡功能也往往会明显的落后于正常儿童。患足足底各区压力的大小顺序与正常人基本是一致的,以足跟和中足部负重为主^[3],但患足外侧缘接触面积增加提示了偏瘫侧足内翻和内侧纵弓有塌陷^[4]。在脑瘫儿童的生物工程学上,个体化的测量和定制矫形鞋垫能部分纠正患儿下肢和足部的生物力线,达到矫正异常姿势运

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动,改善平衡功能,提高患儿步行稳定性。近年来,踝关节持续被动运动(continues passive motion, CPM)对于踝关节功能的康复应用也越来越广。大量文献^[6-7]报道 CPM 可减轻关节疼痛、缓解肌肉张力、维持及改善关节活动度,延缓骨性结构的改变等,但 CPM 运用于脑瘫患儿姿势控制的康复治疗缺乏临床证据。我们经过长期的临床实践,在偏瘫型脑瘫患儿的物理治疗中联合应用矫形鞋垫联合 CPM 治疗,较早期的开始纠正患儿的踝关节肌张力以及异常步态,尽量改善患儿的姿势控制的稳定性,取得较良好的效果,结果报道如下。

1 资料与方法

1.1 一般资料

选择 2016 年 6 月~2017 年 6 月在我院康复科就诊的 56 例脑瘫患儿,年龄 2~4 岁,均有不同程度的脑损伤或脑瘫高危因素病史,经临床和 CT 或 MRI 确诊,诊断符合中国脑性瘫痪康复指南(2015)^[1]制定的标准,临床表现均为运动发育落后,偏瘫肢体功能障碍,踝关节张力较高伴偏瘫步态。纳入标准:① 符

合上述诊断标准者;② 粗大运动功能分级 (GMFCS 分级)^[8]为 I-II 级,踝关节张力在 1-3 级,并能独立步行 5 m 及以上;③ 能主动配合简单指令;④ 患儿家长对本治疗方法知情同意,能配合治疗三个月以上。排除标准:① 不符合上述诊断标准,并伴有严重认知、癫痫、感觉障碍等并发症者;② 进行过下肢矫形手术者;③ 有其他神经系统疾病、前庭功能或小脑功能障碍者;④ 年龄小于 2 岁,或大于 4 岁;⑤ 不配合治疗或存在康复训练禁忌症的患儿;⑥ 家长或监护人不同意。所纳入病例均存在偏瘫步态,排除有严重长短腿及合并其他步态问题的病例。

随机将患儿分为两组。治疗组 28 例,男 15 例,女 13 例,平均年龄 29.7 个月。对照组 28 例,男 17 例,女 11 例,平均年龄 28.5 个月。两组患儿治疗前平衡功能、粗大运动功能 (GMFM)(E 功能区)、肌张力总体评分、年龄、诊断类型、偏瘫类型等基本资料比较差异无统计学意义($p>0.05$),具有可比性,见表 1。

表 1 两组患儿的一般情况比较

Table 1 Comparison of the general information between two groups

Groups	N	Mail	Femail	Age(month)	Spasmodic type	Involuntary movement type	Mixed type	Left hemiplegia	Right hemiplegia
Treatment group	28	15	13	29.7	15	7	6	15	13
Control group	28	17	11	28.5	15	8	5	16	12

1.2 方法

1.2.1 对照组 对照组患儿每日行物理治疗(PT)训练,每次共 30 分钟,每日一次,每周五次。由治疗师一对一进行常规被动活动,行双下肢手动牵伸和松解训练后,予以大运动能力的训练。采用运动疗法、悬吊、关节松动等^[9]。其中,运动疗法包括:① 良肢位摆放:嘱患者夜间睡眠时保持良肢位摆放,抑制痉挛的发生、发展;② 采用 Bobath 技术、Vojta 疗法等经典康复治疗方法,进行双下肢关节活动度训练、重心转移、姿势转换等;③ 坐位平衡、立位平衡、步行等训练;④ 在踝关节物理治疗上进行关节活动度的训练,采用手动牵伸、推拿松解、按摩放松等,每次时间为 15 分钟;⑤ 更侧重于核心肌力的训练,主要涉及大肌群如腰背部、躯干、上下肢近端部位的肌肉。核心稳定性训练主要是针对骨盆、腰背部和躯干的核心肌群训练。同时治疗师在训练中应时刻注意提醒患儿注意偏瘫侧的肢体用力,提高躯干平衡稳定性,可以在偏瘫侧放些发声发光的小物品,以提高患儿的兴趣。一个疗程为三个月。

1.2.2 治疗组 治疗组患儿常规物理治疗训练同对照组,并同时运用足部生物力学矫形技术进行纠正。首先,医生和治疗师对患者下肢进行生物力学评估,包括精细化测量患儿双下肢长度,髌关节内外旋自主运动,胫骨扭转角度范围,前足位、跖跟距和纵弓角的角度测量、评估立姿跟骨休息位和立姿跟骨中立位即距下关节的一致性。根据偏瘫侧足内翻和内侧纵弓塌陷,使用后足内翻附件稳定后足并增加矫形鞋垫的旋后效应;使用前足附件垫在鞋垫内侧纠正前足外翻;通过距下关节中立位塑形以纠正踝关节过度旋转;通过鞋垫和增高附件等调整双下肢不等长。鞋垫为特别设计了 5 度后足内翻角度的 2/3 垫,

可以提高患儿的足跟。附件通过热塑性和矫形鞋垫相互固定。配置后 1 天、2 天、3 天,儿童佩戴时间分别为 1、2 小时和 3 小时。第四天后,他们每天至少穿 5 个小时,要求孩子在 3 个月后再进行下肢生物力学评估。同时加用踝关节持续被动运动 (cpm)治疗,每次 15 分钟,角度恒定为 -45—45 度,每天一次。矫形鞋垫的测量和定制均由我院康复科医生和治疗师共同完成。治疗疗程为三个月。

1.3 评定标准

评定时间为:分别为患儿入选时,治疗后 3 个月进行姿势控制能力评定。以粗大运动功能测量(GMFM)及平衡功能测量(Berg 平衡量表)为标准,结合治疗前后踝关节肌张力及背屈角度疗效等指标进行姿势控制的评定。平衡功能标准:① 显效:平衡改善二级;② 有效:平衡改善一级;③ 无效:平衡改善不明显;④ 恶化:平衡能力下降。踝关节肌张力疗效标准:① 显效:肌张力改善二级;② 有效:肌张力改善一级;③ 无效:肌张力改善不明显;④ 恶化:肌张力增高。

1.4 统计学分析

采用 SPSS 20.0 统计软件,数据以均数 $\pm$ 标准差($\bar{x}\pm s$)表示,两组内和两组间符合正态分布的数据分析用 t 检验,非正态分布数据采用显著性检验(χ^2)或秩和检验,率的比较用 χ^2 检验。以 $P<0.05$ 为差异具有统计学意义。

2 结果

治疗一个月后,对照组有 2 例患儿因家庭原因终止治疗,退出对照组,按其退出时检查值纳入分析。经 3 个月治疗后,两组 BBS 总有效率(显效率与有效率之和)分别为 91.7%和 62.5

%,见表2,两组比较差异有显著性($P<0.05$),治疗组疗效明显优于对照组。两组患儿GMFM比较见表3,两组治疗后GMFM(E功能区分)均较治疗前有所改善($P<0.01$),而治疗组治疗后GMFM(E功能区分)与对照组相比差异显著($P<0.01$),治疗组

患侧肢体运动功能改善明显优于对照组。两组治疗前后踝关节背屈角度、踝关节肌张力比较见表4、5,两组治疗后偏瘫步态均有所改善($P<0.01$),而治疗组治疗后步态稳定性与对照组相比差异显著($P<0.01$),治疗组步态稳定性控制能力改善明显优

表2 两组治疗后平衡功能(BBS)疗效的比较

Table 2 Comparison of the effect of balance function (BBS) after treatment

Groups	N	Obvious effect (n)	Effective(n)	Invalid(n)	Total effective rate(%)
Treatment group	28	12	14	2	92.9
Control group	28	8	11	9	67.9

表3 两组治疗前后粗大运动能力(GMFM)(E功能区分比较)比较

Table 3 Comparison of the gross motor ability (GMFM) before and after treatment (E functional area score comparison) between two groups

Groups	N	Before treatment	After treatment	P
Treatment group	28	34.57± 10.28	53.25± 11.42	<0.01
Control group	28	33.76± 11.56	42.68± 13.57	<0.01
P		0.02	<0.01	

表4 两组治疗前后踝关节背屈角度变化的比较

Table 4 Comparison of the changes of ankle flexion angle before and after treatment between two groups

Groups	N	Before treatment	After treatment	P
Treatment group	28	-6.12± 3.47	1.89± 4.32	<0.01
Control group	28	-5.96± 3.28	-1.59± 4.14	<0.01

表5 两组治疗前后踝关节肌张力疗效的比较

Table 5 Comparison of the curative effect of ankle muscle tension after treatment between two groups

Groups	n	Obvious effect (n)	Effective(n)	Invalid(n)	Total effective rate(%)
treatment group	28	12	13	3	89.3
Control group	28	7	13	8	71.4

于对照组。

3 讨论

成熟的儿童脑瘫康复治疗应该是围绕着"功能"、"活动"、"参与"障碍及其背景因素(环境的、个人的)之间的相互性进行的,更应该贯穿于康复的全过程^[10]。除去日常功能训练,物理治疗的方法也灵活多变,有时也会借助辅助器具来提升疗效,来帮助患儿适应复杂多变的环境^[11]。研究表明,矫形器可抑制足的原始反射,改善患儿的异常姿势和提高平衡能力^[12-14]。在小儿脑瘫的综合治疗中,如果适当引入辅具,会有利于正常的运动模式形成,防止异常姿势的进一步加重,是康复治疗中的重要方法^[15-17]。但在我国脑瘫儿童的康复过程中,矫形器仍然处于相对落后的状态^[18]。所以,更加需要在早期预防挛缩和畸形方面找到一种非常有效的治疗方法。生物力学矫形鞋垫在配戴于患儿的身体时,可以利用生物力学的原理来预防畸形,在一定程度上可以弥补患儿的机械运动功能和异常姿势形成^[19]。踝关节cpm治疗引入偏瘫型脑瘫儿童的康复治疗有以下优势:持续治疗作用、无疼痛及明显不适,患儿主动配合程度高、不良刺激小等等。

被动活动可以增加毛细血管DNA含量,修复受损组织,造成机械分离、断裂肌腱修复区及周围组织的连接,防止鞘组织的内生。它不仅刺激组织本身的再生,而且能抑制和消除修复区炎症组织的生成,从而防止粘连^[20]。在这项研究中,治疗组经过不断的被动牵伸,拇外翻挛缩和痉挛得到缓解,协调性有所增强。从而使治疗后患儿踝部张力降低,踝关节活动范围改善,步行稳定性提高^[21]。踝关节CPM是大规模的运动缓慢的被动周期正弦曲线的运动,肌肉凝胶成分如粘性水和蛋白多糖减少,减少肌肉僵硬、增加弹性,有效缓解痉挛,但生物力学变化是以长期积累的效果达到稳定的效果^[22]。

踝关节的CPM由控制器设置,使患者能够在设定范围内进行安全和恒定的被动运动。根据患者的病情,可以确定不同的运动方向、运动速度、关节活动的最大角度和牵伸时间。脑性瘫痪儿童运动功能的恢复是以大脑的可塑性为基础的。肢体的重复活动和被动活动对脑可塑性有着重要的影响^[23]。痉挛是速度依赖性牵张反射增强。因此,缓慢而不断周期性被动活动可降低肌梭敏感性,降低牵张反射和缓解小腿三头肌痉挛^[24-26]。平衡能力是儿童独立走路的基本保证。维持人体平衡包括3个方面:感觉输入、中枢整合和运动控制。本体觉直接影响行走完成

[27-29]。脑瘫患儿通过踝关节 CPM 训练,在反复的踝关节的被动运动中可以刺激踝关节的关节感和位置感,促进本体感觉的恢复和提高儿童的平衡能力。实际临床工作中,我们发现,偏瘫型脑瘫患儿不仅是肢体瘫痪,还伴有躯干瘫痪,通过腰腹部肌肉力量训练和核心力量训练能明显改善偏瘫型脑瘫患者的平衡和姿势控制能力^[30]。

本研究结果表明个性化及有效的测量、定制矫形鞋垫联合 CPM 治疗有助于促进偏瘫型患儿运动功能恢复和姿势控制的稳定性。当然,本研究为初探性研究,虽效果明显,但仍有不足,样本量小,治疗方案中变异因素较多,对左侧偏瘫和右侧偏瘫患者未分类讨论,对结果的解读应当更为保守、谨慎,仍然需要进一步扩大研究对象和进行随访研究。

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