

## The effect of deep cross friction massage on spasticity of children with cerebral palsy: A double-blind randomised controlled trial

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### Abstract

**Objective:** To find out the effect of deep cross-friction massage on spasticity in children with cerebral palsy.

**Methods:** This double-blind randomised controlled trial was conducted at the National Institute of Rehabilitation Medicine, Islamabad, Pakistan, from January to July 2013, and comprised paediatric patients with spastic diplegic cerebral palsy. The participants were equally divided into control and treatment groups by a staff member unaware of the treatment (allocation ratio 1:1). The control group received routine physiotherapy, while the experimental group was additionally given deep cross-friction massage for 30 minutes, 5 times a week lasting 6 weeks. The outcome was measured using Modified Ashworth Scale and functional level scale before the treatment and 6 weeks later. Baseline information and characteristics of the patients were also recorded. SPSS 20 was used for data analysis.

**Results:** Of the 60 patients, there were 30(50%) in each group. The control group consisted of 14(46.7%) males and 16(53.3%) females compared to 16(53.3%) males and 14(46.7%) females in the experimental group ( $p=0.72$ ). The overall mean age was  $6.03 \pm 1.73$  years. All patients (100%) were followed up for a period of 6 weeks and there was not a significant ( $p=0.26$ ) improvement in experimental group compared to control group evident on Modified Ashworth Scale. The experimental group, however, had significant improvement after 6 weeks compared to the baseline values ( $p<0.001$ ). However, functional level did not improve ( $p=0.55$ ) by the end of study.

**Conclusion:** Deep cross-friction massage is an efficacious treatment option for the management of spasticity in children with cerebral palsy.

**Keywords:** Ashworth scale, Cerebral palsy, Massage, Children, Spasticity. (JPMA 67: 87; 2017)

### Introduction

Cerebral palsy (CP) is a syndrome of motor impairments characterised by non-progressive disturbances taking place in developing foetal and infant brain.<sup>1,2</sup> The disorder varies in the clinical presentation, timing of the lesion, site and severity of the impairments.<sup>3</sup> The prevalence of cerebral palsy is reported between 2 and 3 per 1,000 live births.<sup>4,5</sup> Spastic CP, particularly spastic diplegia, is the most common form of CP, accounting for 50-60% of total cases.<sup>2,6,7</sup> Spasticity has severe adverse effects on muscles and joints, particularly in extremities.<sup>1</sup> Both limbs, however, may exhibit difference in pattern of spasticity from each other.<sup>4</sup> Spasticity is generally worse in the lower limbs in children with bilateral involvement.<sup>6</sup> The most commonly involved lower limb muscles include gastrocnemius, soleus, adductors, hamstrings, psoas and rectus femoris.<sup>1,6</sup>

Massage is one of the oldest and most widely used treatments in complementary and alternative medicine,

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with more than 75 forms of it practised today.<sup>8,9</sup> Deep-friction massage (DFM), which was introduced by James Cyriax for treating tendon disorders, involves application of forces perpendicular to the fibres as to separate each fibre and align the newly formed collagen.<sup>9,10</sup> It helps to promote analgesia, local hyperaemia, and reduce adherence of scar tissue to muscles, tendons and ligaments.<sup>9</sup> Moreover, it helps to break subcutaneous adhesion and prevent fibrosis, leading to improved sensory feedback and decreased pain.<sup>11</sup>

Previously, studies have been conducted to support the role of DFM in treating tendopathies, chronic low back pain, and spasticity in stroke patients.<sup>9-11</sup> However, data on its role in CP patients, particularly in reducing spasticity, is unavailable. One study has been conducted on the use of Swedish massage, but not on the deep-friction massage, in reducing spasticity in CP patients which did not show significant improvement in the intervention group.<sup>12</sup> Therefore, the current study was planned to find out the effect of deep cross-friction massage on spasticity in children with CP.

### Patients and Methods

This double-blind randomised controlled trial was conducted at the National Institute of Rehabilitation Medicine (NIRM), Islamabad, Pakistan, from January to

July 2013, and comprised child patients with spastic diplegic CP.

Approval for the study was obtained from the institutional committee and written informed consent was taken from the family members of the participants.

Patients were initially assessed by a paediatric specialist at the NIRM's Department of Paediatrics and cases diagnosed with cerebral palsy were referred to physiotherapy department (Figure). The patients were diagnosed based on their history and physical examination. Inclusion criteria were: spastic cerebral palsy; diplegic cerebral palsy based on limbs involved; aged between 3 and 9 years; and presence of mild mental retardation (an intelligence quotient [IQ] of 50 or above). Patients excluded from the study were children with severe contractures in the limbs; presence of moderate to severe mental retardation (IQ below 50); and children with multiple disabilities, e.g. cerebral palsy and spina bifida.

Patients diagnosed with cerebral palsy and referred to physiotherapy department were randomly allocated to control and treatment groups by a masked staff member using computer generated permuted block randomisation. An opaque envelope was given to each subject assigned to either of the group. A staff member, who was unaware of the treatment being given, randomly allocated the participants to each group with an allocation ratio of 1:1. Participants and outcome assessors were blinded to treatment. However, therapists were unmasked to the treatment given.

Both groups were given routine physiotherapy treatment which consisted of applying hot pack for 15 minutes and Bobath treatment (reflex inhibitory postures) followed by stretching the Achilles tendon (10 repetitions with at least 8 seconds hold); however, intervention group was additionally provided with cross-friction massage on both the legs at soleus and gastrocnemius along Achilles tendon. Therapist always started massaging with the right leg first. Treatment session for both groups lasted for 30 minutes with each treatment session for 5 times a week for 6 weeks. At the end of each session, patients were assessed for improvement by an assessor blinded to the treatment.

After allocation of the patients to the study groups, baseline information related to patient was collected including demographic data, age, gender, birth history, clonus, post-natal complication, type of labour, convulsions, parental education and occupation. The level of spasticity was measured using Modified Ashworth Scale (MAS). First reading of MAS was taken for

both the groups at the start of the study and second reading was taken after 6 weeks. Functional level was assessed using a 9-point scale; the readings were taken at the start of the study and after six weeks. The components of functional level scale included no function, turning over, supported sitting, sitting, crawling, supported standing, standing, supported walking and walking. Family members of all 60 patients agreed to be part of the study and were followed up for six weeks. As the patients were treated free of any cost, none of the patients was lost to follow-up during the study.

Sample size calculation was based in accordance with previous literature<sup>12</sup> and calculation was done through OpenEpi where confidence level was set to 99%. Statistical analysis was done using SPSS 20. Baseline information related characteristics of participants including demographic data, age, gender, birth history, clonus, post-natal complication, convulsions and parental education and occupation were presented as frequencies and percentages.

Both groups were compared for MAS and functional level at the beginning of study and after six weeks. Comparative analysis was done using chi-square test for categorical variables, and independent simple t-test and paired t-test for continuous variables.  $P < 0.05$  was considered statistically significant.

## Results

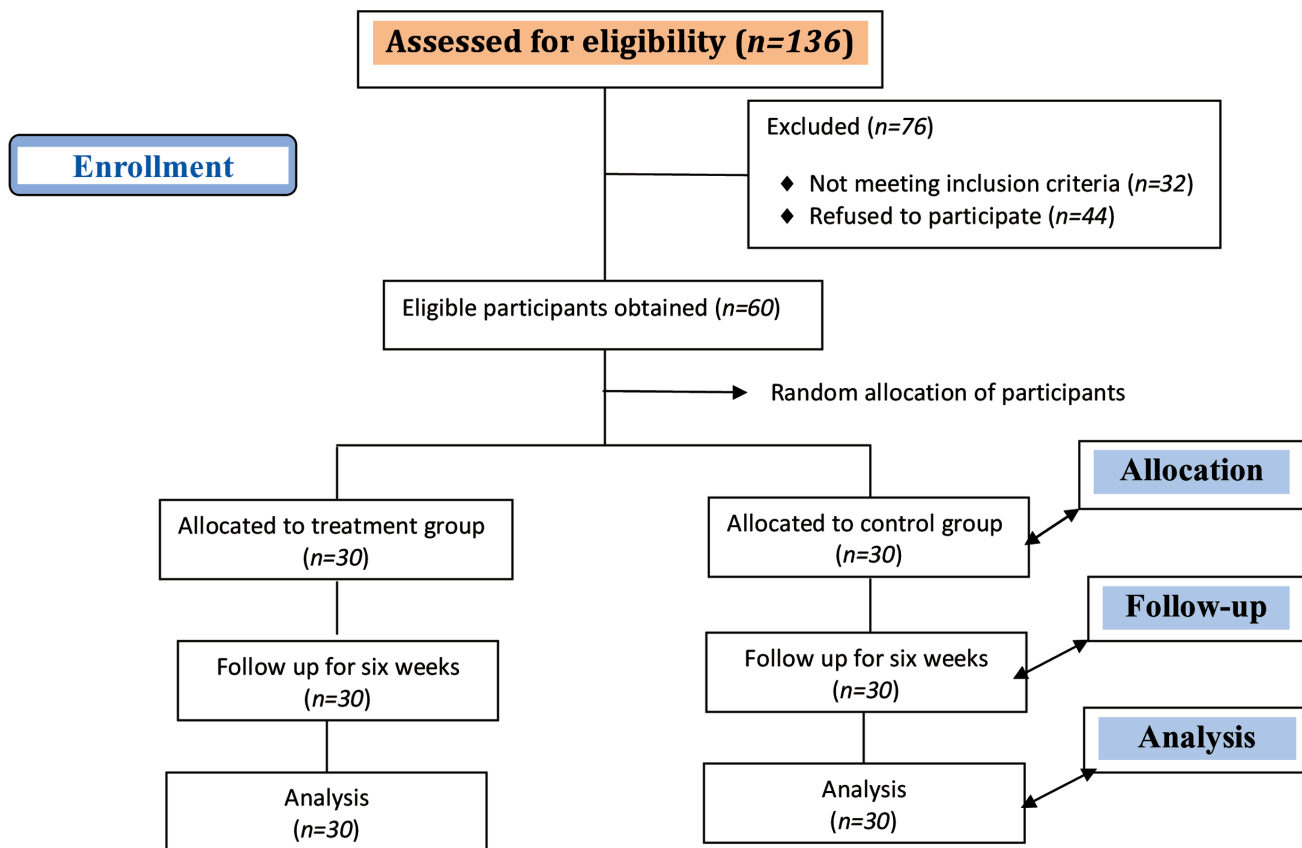
Of the 60 patients, there were 30(50%) in each group. The control group consisted of 14(46.7%) males and 16(53.3%) females compared to 16(53.3%) males and 14(46.7%) females in the experimental group ( $p=0.72$ ). The overall mean age was  $6.03 \pm 1.73$  years. The mean age for the control and experiment group was  $6.0 \pm 1.85$  and  $6.07 \pm 1.67$  years, respectively ( $p=0.58$ ). Birth was full term in 18(60%) control group participants compared to 16(53.3%) in the experimental group, whereas it was premature in 12(40%) and 14(46.7%) cases, respectively ( $p=0.83$ ). The mode of delivery was normal in 14(46.7%) cases of the control group and 18(60%) of the experimental group ( $p=0.34$ ). Clonus was elicitable in 10(33.3%) cases of the control group and 2(6.67%) of the experimental group, and non-elicitable in 20(66.7%) and 28(93.3%) cases, respectively (Table-1).

In terms of mean MAS of controls and cases, there was no significant difference between the groups ( $3.87 \pm 1.19$  vs  $3.80 \pm 0.86$ ) at the beginning of the study ( $p=0.86$ ) and also after 6 weeks ( $3.73 \pm 1.22$  vs  $2.87 \pm 0.74$ ) ( $p=0.26$ ). However, comparative analysis within the groups showed significant improvement in the intervention group after 6 weeks ( $p < 0.001$ ). There was no significant difference

**Table-1:** Baseline characteristics of the patients.

	Study population (n=60)	Control group (n=30)	Experimental group (n=30)	p-value
Age (years)	6.03±1.73	6.0±1.85	6.07±1.67	0.58*
Gender (numbers)				0.72**
Male	30 (50%)	14 (46.7%)	16 (53.3%)	
Female	30 (50%)	16 (53.3%)	14 (46.7%)	
Birth history				0.83**
Full term	34 (56.7%)	18 (60%)	16 (53.3%)	
Premature	26 (43.3%)	12 (40%)	14 (46.7%)	
History of delivery				0.34**
Normal	32 (53.3%)	14 (46.7%)	18 (60%)	
Forceps	2 (3.3%)	0 (0%)	2 (6.67%)	
Caesarean	26 (43.3%)	16 (53.3%)	10 (33.3%)	
Post-natal complications				0.95**
Fever	8 (13.3%)	4 (13.3%)	4 (13.3%)	
Late cry	34 (56.7)	18 (60%)	16 (53.3%)	
Ventilated	18 (30%)	8 (26.7%)	10 (33.3%)	
Clonus				0.46**
Elicit able	12 (20%)	10 (33.3%)	2 (6.67%)	
Not elicitable	48 (80%)	20 (66.7%)	28 (93.3%)	
Convulsions				1.0**
Present	16 (26.7%)	6 (20%)	10 (33.3%)	
Absent	44 (73.3%)	24 (80%)	20 (66.7%)	

\*p-value is calculated using independent t-test; \*\*p-value calculated using Chi-Square test.



**Figure:** CONSORT flow diagram.

**Table-2:** Comparison of outcomes from baseline to 6 weeks in the DFM and control groups.

	Control group (n=30)	Experimental group (n=30)	p <sup>a</sup>
<b>Modified Ashworth Scale</b>			
At the start of the study	3.87±1.19	3.80±0.86	0.86
After 6 weeks	3.73±1.22	2.87±0.74	0.26
	0.16 <sup>b</sup>	<0.001 <sup>b</sup>	
<b>Functional level</b>			
At the start of the study	7.20±1.70	6.80±2.04	0.56
After 6 weeks	7.27±1.67	6.87±1.92	0.55
	0.33 <sup>b</sup>	0.33 <sup>b</sup>	

<sup>a</sup>p-value for between the groups change using independent t-test.

<sup>b</sup>p-value for within the groups change using paired t-test; p<0.05 as statistically significant.  
DFM: Deep-friction massage.

observed between the groups with respect to functional level at the beginning (7.20±1.70 vs 6.80±2.04) and after 6 weeks (7.27±1.67 vs 6.87±1.92) of the study (p=0.56 and p=0.55, respectively) (Table-2).

## Discussion

Significant reduction in spasticity was found after 6 weeks of DFM within the experimental group (p<0.001). However, between the two groups, spasticity reduction was not significant (p=0.26). Moreover, there was no significant improvement observed in the functional level of study subjects (p>0.05) on both within and between the group analysis. Despite the fact that both groups were homogenous at baseline (p>0.05, except for the clonus i.e. p<0.05), we could only see improvement in the DFM group but that too only in spasticity reduction.

Massage has been used to improve blood and lymphatic circulation, enhance inelastic and elastic properties of muscles and connective tissue, alleviate muscle pain and promote relaxation.<sup>9</sup> It has been reported that mechanical properties and stretch reflex of spastic muscle differ from normal muscles.<sup>6,13</sup> Stretch reflex is responsible for regulation of muscle stiffness and exaggerated response as this is responsible for hypertonia.<sup>13</sup> Consequently, treatment is directed towards reducing stretch reflex which has been demonstrated by O'Dwyer et al.<sup>14</sup> in young people with CP through the use of visual feedback. Deep cross-friction massage is used to stretch spastic muscles and bring the sarcomere length to an optimal level.<sup>11</sup> Physical contact in this technique aids in decreasing the pain and benefiting the patient through psychological effects and by acting on the gate control theory.<sup>9,15</sup> M Hernandez Reif et al. found that children receiving massage therapy showed fewer cerebral palsy symptoms, including overall less rigid muscle tone,

reduced spasticity, and improvement in gross and fine motor functioning.<sup>16</sup> Another study by Hernandez-Reif et al.<sup>17</sup> also reported findings on improved muscle tone for young children with Down's syndrome receiving massage therapy. Alizad et al. found significant reduction rate of tonicidity in trunk and upper limbs in patients receiving traditional Swedish massage.<sup>12</sup>

From a diagnostic point of view, MAS is the most commonly used testing method for the assessment of spasticity.<sup>11,18</sup> This is a 6-point scale with considerably good reliability to measure the resistance to passive stretch.<sup>7,19</sup> In our study, significant reduction in spasticity was not observed in intervention group compared to the control group at the end of the study (p=0.26). However, within the group analysis showed significant improvement in the intervention group after 6 weeks (p<0.001). Though, the duration of follow-up was very short (6 weeks), the multiple-dose effects leading to enduring results were still evident. S. Beider advocates multiple-dose effects of massage therapy on variables considered to be more enduring. He also classifies the potential effects of massage therapy primarily to be physiological, behavioural or affective in nature. Physiological effects are related to vital processes of the recipient including the muscle tone.<sup>9</sup> Mccgregor et al. used transverse-friction massage on calf muscles of patients with spastic diplegia and suggested that it resets sarcomere lengths and leads to improved proprioceptive feedback.<sup>20</sup> Massage has been widely used in previous studies, with one study from the University of Glasgow, reporting increased range of motion after massage in patients with spastic diplegia.<sup>8</sup>

Zhou XJ and Zheng K applied combined therapy method, based on traditional Chinese medicine (including massage) and western medicine plus family supplemental therapy, on 140 children with cerebral palsy. This approach was effective in a majority of CP patients improving their post-treatment social and motor adaptation capacities (p<0.01).<sup>21</sup> We did not observe a significant improvement in functional level in the treatment group receiving deep cross-friction massage (p=0.55), following 6 weeks duration. This was possibly because the psychological issues of the patients were not addressed. In a study from the United Kingdom, therapists taught 42 simple massage techniques to parents for eight weeks. Parents reported improvements in children's joint mobility, muscle tone, sleep patterns, and response to routine physiotherapy.<sup>22</sup> Stefan Nilsson et al. used massage therapy in children and adolescents with cerebral palsy and found decrease in post-operative pain and discomfort in the study population. The study contained literature review of studies on the use and effects of massage therapy, most of

which were concerning psychological aspect of patients with cerebral palsy.<sup>23</sup>

The strength of the current study is that it is the first study on the role of deep cross-friction massage in managing spasticity in patients with cerebral palsy from Pakistan. With limited available evidence, it contributes to the literature on the topic. But the study has certain limitations as well. Firstly, there was not any non-treated group for comparing effectiveness of deep cross-friction massage (apart from that to the routine physiotherapy group). Secondly, generalising findings of this study is difficult because of the small number of subjects with a limited follow-up duration. It will be necessary if deep cross-friction is compared for the non-treatment group to see the effectiveness in reducing spasticity in patients with cerebral palsy. It will also be necessary to conduct further randomised trials that examine the long-term effects of deep cross-friction massage in these patients during a sufficiently long follow-up period to collect sufficient evidence to establish DFM as standard treatment modality for the management of spasticity of CP children and to improve their functional level.

## Conclusion

DFM was found to be a better and efficacious treatment option for management of spasticity in children with cerebral palsy than the traditional physical therapy alone. However, its role in improving function could not be established but it is speculated that reducing the spasticity may help benefit in functional level and performance.

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**Conflict of Interest:** None.

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