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# Myofascial Structural Integration: A Promising Complementary Therapy for Young Children With Spastic Cerebral Palsy

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**Abstract**

Increasing evidence suggests that structural changes within muscle and surrounding tissues are associated with creating and/or increasing muscle stiffness and resistance to stretch in spastic cerebral palsy. The goal of this preliminary study was to determine whether myofascial structural integration, a specific, complementary, deep-tissue manipulation technique designed to reorganize muscle and surrounding soft tissue, would improve motor function in young children with spastic cerebral palsy. In a randomized crossover design, the authors assessed motor function using established measurement techniques at baseline and after the treatment and control conditions in 8 children with spastic cerebral palsy, aged 2 to 7 years. The average change for the group after therapy was greater than the change after the control condition. Results showed that there were major improvements in 6 children after the therapy; 3 of the children also showed improvements after the control phase. Myofascial structural integration holds promise as a novel complementary treatment for spastic cerebral palsy.

**Keywords**

cerebral palsy, myofascia, spasticity, manipulation, muscle

Cerebral palsy is the most common physical disability in childhood, affecting 2 to 4 children per 1000, aged 3 to 10 years.[1] Cerebral palsy results from a nonprogressive insult to the developing brain early in life. The most prevalent type is spastic cerebral palsy, a condition in which affected muscles have a velocity-dependent increased sensitivity to stretch, causing stiffness, tightness, interference with movement, and joint contracture.

Because cerebral palsy cannot be cured, treatment is focused on relieving symptoms and improving motor function. The mainstays of treatment for young children are physical and occupational therapy that aim to maintain flexibility, increase strength, and improve functional abilities. Medical options such as oral or intrathecal baclofen,[2] botulinum toxin muscle injections,[3,4] and orthopedic surgery can be at least temporarily beneficial. However, these methods are limited by their invasive nature, negative side effects, and variable functional effectiveness. Noninvasive techniques, such as constraint-induced movement therapy and serial casting can lead to improved functional movement patterns[5,6] but at least temporarily limit motor abilities in affected or unaffected limbs.

Increasing evidence suggests that structural changes within the spastic muscles and surrounding tissues are associated with creating or increasing muscle stiffness and resistance to stretch.[7-11] Specific changes include altered muscle fiber size and distribution, proliferation of the extracellular matrix, altered matrix mechanical properties, and increased muscle cell stiffness.[9] The extracellular matrix of spastic muscle appears disorganized and hypercellular[10] and thereby can interfere with muscle mechanics. Supporting this hypothesis, a study evaluating a surgical tendon transfer procedure found that disruption of fascial connections was necessary in addition to tendon transfer to significantly change the force dynamics in the spastic limb after surgery.[12] Another study of a surgical method for releasing myofascial strain in spastic limbs of children with cerebral palsy found significant functional improvement postsurgically, suggesting that restriction in the myofascia plays an important role in spasticity.[13] Based on these findings, we reasoned that bodywork procedures targeting the muscle, extracellular matrix, and fascial connections could have beneficial effects on spasticity and contracture seen in cerebral palsy.

The goal of this preliminary study was to assess the therapeutic potential of myofascial structural integration as a

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complementary treatment for young children with spastic cerebral palsy. Myofascial structural integration is a specific deep-tissue manipulation technique that focuses on putting the body into alignment and bringing joints toward their optimal structural positions.[14] In this method, developed by Ida P. Rolf, PhD, therapists use guided manual pressure to relax muscles and loosen the fascial layers between muscles, allowing the muscles to slide past one another. The changes induced by manipulation are designed to allow more efficient patterns of movement and to encourage the persistence of improved alignment.[15] The novelty of this therapy for the management of cerebral palsy is that it directly targets reorganization of local muscle and fascial tissue structure to restore or maintain normal function. We hypothesized that myofascial structural integration would be more effective than a control condition in improving motor function and related abilities in young children with spastic cerebral palsy.

## Methods

We enrolled 8 children with spastic cerebral palsy of mild to moderate severity (Gross Motor Function Classification Measure levels II, III, and IV), aged 2 to 7 years old, in a randomized crossover study (see Table 1). The protocol was approved by the institutional review board at Stanford University. Parents gave informed consent prior to their child's participation. Children were recruited from clinics at Stanford University and California Children's Services. All children continued to receive physical and occupational therapy and to participate in all other regular recreational activities (eg, swimming) during the study. Each child was scheduled for 10 weekly 60- to 90-minute sessions of the intervention (myofascial structural integration) and 10 weekly sessions of a control intervention (play). Half of the children underwent play followed by myofascial structural integration and the other half in the reverse order. A single Certified Advanced Rolfer (KSP) with 32 years of experience working with young children provided the therapy in her private office. The myofascial structural integration treatments followed the specific, structured progression established by Dr Rolf, wherein the therapist systematically treats the core and the extremities of the body over the course of 10 sessions. As is standard in myofascial structural integration, the protocol was modified minimally to accommodate the needs of young children in the following ways: the position of the child during treatment could vary, dictated by the child's comfort (eg, work was done on the floor during play, standing, or in the parents lap rather than only on a table); children were allowed breaks as needed; and the parents were present and interacted with and supported their child verbally or through play. The interactive play sessions were conducted by a single individual (ABH). Three children received less than the full play protocol because they had planned family vacations; to keep the duration of each treatment period constant, play sessions were cancelled.

We administered an assessment battery at baseline and after each treatment phase. The primary outcome measure was the Gross Motor Function Measure-66, a validated measure of motor function that grades the child on a specific series of movements and gives a numerical score out of 100. Evaluations were administered by a trained medical student (ABH) and scored both during and after the session using video footage. One third of the videotaped sessions were evaluated and rescored by a second examiner (HMF). Differences in scoring were minimal and typically within the margin of error of the measurement tool. Differences in scoring were discussed until consensus was reached. Additional measures of function were also included, following the conceptual framework of the International Classification of Functioning, Disability, and Health: For body structure and function, we assessed passive ankle range of motion, and for participation, we obtained parent reports of social competence and behavior problems on the Child Behavior Checklist[16] and International Classification of Functioning interview.[17] Parent satisfaction was assessed by parent ratings and an exit interview.

## Results

All the participants tolerated the treatments without difficulty. Results showed that 6 of 8 children had improvement in their Gross Motor Function Measure score during myofascial structural integration treatment (see Figure 1). One child with severe cognitive and visual impairment could not follow instructions and was unable to cooperate with Gross Motor Function Measure testing. Her individual results are shown but are excluded from the mean score calculations. The mean change on the Gross Motor Function Measure score after treatment for the other 7 (of 8) children overall was +4.49; mean change after play was +1.52. For 2 children younger than age 5 years (Gross Motor Function Classification Measure level II), the average change on the Gross Motor Function Measure score after approximately 3 months of treatment was +7.4. This degree of change exceeds the expected average change on the Gross Motor Function Measure over 12 months for this age (anticipated mean change of +7.00, +3.19, and +3.35 for Gross Motor Function Classification Measure levels II, III, and IV, respectively).[18] For the 5 children older than age 5 years, the mean change on the Gross Motor Function Measure score after treatment was +3.2 over 3 months; this change also exceeds the expected average change on the Gross Motor Function Measure over 12 months for that age (near 0 for all Gross Motor Function Classification Measure levels).[18] We found that 3 of the children showed improvement only during treatment, and 3 children showed improvement in scores after treatment and after the control condition.

We did not observe consistent improvements in ankle range of motion (ROM) across the group. However, 3 children showed considerable improvements in ankle dorsiflexion after myofascial structural integration treatment (see Table 1). No trend was observed in the International Classification of Functioning interview responses. All the children (including 2 children who did not show improvement in Gross Motor Function Measure score) experienced improvements to their health and well-being after myofascial structural integration treatment that were not reflected in the measured outcomes but were reported by parents at the exit interview. Parents reported positive changes in their children's appetite (n = 5), bowel function (n = 1), speech (n = 2), drooling (n = 3), and mood and maturity (n = 4). Out of 8 parents, 7 also reported an increase in height and/or weight during the treatment in children previously below the normal growth curve.

Parent satisfaction was high; the mean ratings were 9.6 out of 10 for each study phase. Several families have elected to

**Table 1.** Characteristics and Results for the 8 Study Participants[a]

| ID | Age Sex GMFCS | Cerebral Palsy Type | Additional Functional Impairments | Initial Condition | MSI Change GMFM Score | Play Change GMFM Score | ROM[b] (R/L) | Study Observations After MSI | Parent Reports of Change After MSI |
|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 years, M, level II | Spastic diplegia | — | Play | 6.00 | 0.33 | ++/++ | Learned to run and jump; better balance; decreased tripping/falling | Increased weight/height/strength; increased appetite; improvements in maturity and mood |
| 02 | 2 years, F, level II | Spastic diplegia | Verbal delay | MSI | 9.6 | −0.71 | ++/+ | Learned to walk on her own; began babbling and vocalizing | Increased weight/strength; increased appetite; drooling reduced; speech improved; increased confidence |
| 03 | 5 years, F, level IV | Mixed quadriplegia | Severe visual and cognitive impairment | Play | −6.29[c] | −2.00[c] | −/++ | Smoother, more coordinated movements; able to lie prone for extended periods | Sleeping and eating better; happier/more relaxed; walking with 1 hand support; better balance; more vocalization; less bruxism |
| 04 | 6 years, M, level II | Spastic hemiplegia | Visual impairment | MSI | 6.59 | 0.83 | −/− | Stopped needing brace on right leg; better coordination | Increased weight/height/strength; increased appetite; better balance; climbing stairs without rail |
| 05 | 5 years, M, level II | Spastic and dystonic quadriplegia | Dysarthria | Play | 2.17 | 2.06 | −/+ | Much better coordination and self control; increased speech output | Increased weight/height; better balance and stair climbing; relearned crawling; drooling reduced |
| 06 | 7 years, M, level II | Spastic diplegia | Cognitive impairment | MSI | 4.18 | 5.59 | +/− | Better balance; greatly decreased tripping and falling | Increased weight/strength; increased appetite; drooling and constipation reduced; increased confidence and maturity |
| 07 | 6 years, M, level IV | Mixed quadriplegia | Cognitive impairment | MSI | 0.42 | 0.00 | −/− | Greater ease in transitioning between positions; began crawling and climbing independently | Increased weight/strength; more opinionated and social; less daytime bruxism |
| 08 | 5 years, F, level III | Spastic diplegia | — | Play | 2.47 | 2.53 | −/+ | Able to balance standing for more than 1 minute | Increased weight/height/strength; better balance; can take steps on her own now |

[a] Table shows cerebral palsy type and severity based on Gross Motor Function Classification Measure (GMFCS) level, additional impairments, and results of multiple outcome measures after myofascial structural integration (MSI) and control (play) phases.
[b] "+" Indicates whether this child showed improvement in this category in comparison to the control condition in the right and left (R/L) ankle; "++" indicates that the improvement was greater than that seen in the control condition.
[c] This child had severe cognitive and visual impairment and was not able to cooperate with the Gross Motor Function Measure (GMFM) testing. Her calculated GMFM scores declined over the course of the study though her parents reported positive changes associated with MSI, and her motor function appeared stable by clinical examination.

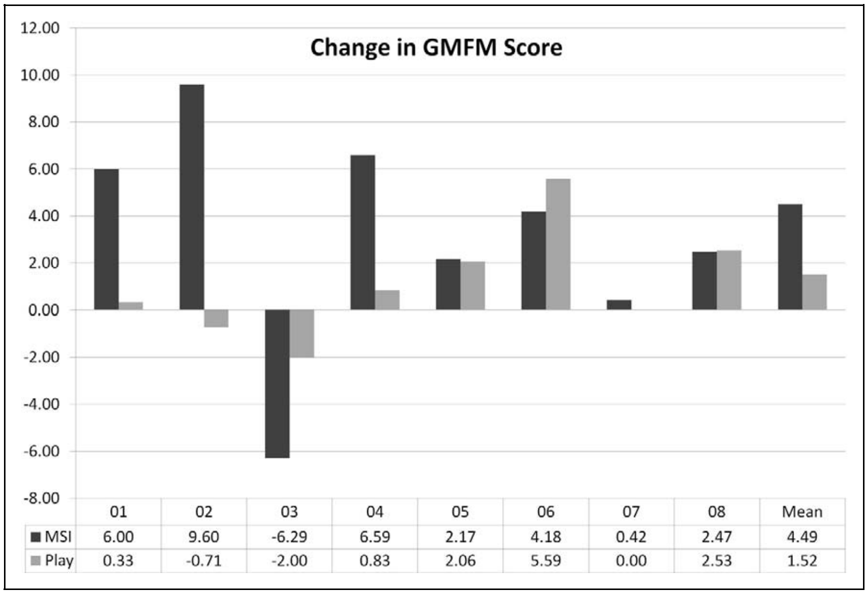


**Figure 1.** Change in Gross Motor Function Measure (GMFM) score for 8 study participants after Myofascial Structural Integration (MSI) and control (play) phases

continue myofascial structural integration with an infrequent maintenance schedule since the completion of the study because of the positive effects on the child. The children became increasingly relaxed and interactive with the therapist as the sessions proceeded, and parents frequently reported that the children looked forward to their weekly sessions.

## Discussion

These preliminary study results indicate that using myofascial structural integration as a specific, complementary technique to loosen and realign muscles and joints could facilitate improved motor function in young children with spastic cerebral palsy. As such, this therapy holds promise as a complementary treatment in the comprehensive management of young children with cerebral palsy. Our results are similar to those of a study done in the 1980s using the same technique in older children with cerebral palsy, which found changes in walk velocity, stride length, and cadence in mildly and moderately affected children as a result of treatment.[19] A more recent investigation of osteopathic manipulative treatment, which includes myofascial release techniques, also found the treatment to provide substantial functional improvement in children with cerebral palsy.[20] The advantages of myofascial structural integration as an approach are that it targets changes in the muscle and fascial tissue directly, it is a noninvasive therapy, and it does not interfere with developing movement patterns. Improving or normalizing function at young ages is particularly important for capitalizing on the neural plasticity in the developing brain.

Though preliminary results are promising, replication with a larger sample size and evaluations by observers unaware of the status of the children will be necessary to establish whether myofascial structural integration is a beneficial, complementary intervention for spasticity in all children with cerebral palsy or in selected subgroups. In a follow-up study, we plan to evaluate the nonmotor benefits of myofascial structural integration, including positive changes in growth (height and weight) and body function (bowel and drooling), activity, and participation. Ultimately, in future research, if myofascial structural integration continues to show benefits for young children, we would like to assess whether improvements in motor function are accompanied by changes in local tissue structure, potentially via direct ultrasound visualization.

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### Authors' Contributions

ABH is a medical student who contributed to the design of the study, recruited the participants, and conducted the control play condition. She had access to all the data as she analyzed it. She also searched the medical literature for supporting studies and co-wrote the manuscript. KSP is a Certified Advanced Rolfer who assisted in designing the study, donated 10 sessions of myofascial structural integration treatment for each of the participants, and kept detailed notes of parent comments and child improvements. She also participated in writing the manuscript. HMF contributed to the design of the study, provided overall supervision to Ms Hansen and Ms Price, participated in the analysis and interpretation of data, and co-wrote the manuscript. Dr Feldman had access to the study data that support publication.

### Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## Ethical Approval

This study was approved by the Stanford University Institutional Review Board. All parents gave informed consent before participating.

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