

Efficacy of Different Types of Mulligan Techniques in Management of Children with Spastic Diplegia with Crouch Gait

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Abstract: Mulligan techniques focus on improving the movement, range of motion and reducing pain on movement in adults. The technique is not inadequately studied in children with cerebral palsy. Three Mulligan techniques i.e. adductor elongation, bent leg raise and rectus elongation was applied in children with diplegic spastic cerebral palsy with crouch gait. Four children with diplegic spastic cerebral palsy with crouch gait participated in a prospective study carried out at SNEH RERC over a period of 12 weeks. Adductor elongation, bent leg raise and rectus elongation treatment was given to each child for an average of 1 hour-3 times a week based on the Mulligan techniques. The primary outcome measures included Thomas Test and Duncan Ely Test (hip flexor angle), adductor spread and Tardieu's scale for hamstrings to measure Popliteal angle and secondary outcome measures included Gross Motor Functional Classification Scale (GMFCS), Silfverskiöld test, Ashworth's test for iliopsoas, hamstrings, tendo-achilles and selective motor control for hip, knee and ankle respectively. After the completion of 12 weeks, an application of the three Mulligan techniques showed highly significant changes in the range of hip, knee and ankle as seen using the above outcome measures. Mulligan techniques such as adductor elongation, bent leg raise and rectus elongation may significantly improve mobility of the joint and extensibility of the muscle tissue in children with diplegic spastic cerebral palsy with crouch gait. Further research is warranted in this area.

Keywords: Mulligan Techniques, Crouch Gait, Spastic Diplegia, Cerebral Palsy, Adductor Elongation, Bent Leg Raise, Rectus Elongation

1. Introduction

Cerebral palsy (CP) is a spectrum of permanent disorders affecting the movement and posture, causing activity limitation, caused due to non-progressive disturbances that occurred in the developing foetal or infant brain during the pre, peri or post-natal stage. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and behaviour, by epilepsy, and by secondary musculoskeletal problems. [1] Spasticity results from pyramidal tract lesions in the developmental brain and is seen in 60% of children with cerebral palsy. Spastic diplegic cerebral palsy often shows

presence of crouch gait which is characterized by excessive hip flexion, knee flexion, and ankle dorsiflexion. Crouch gait is generally seen as child grows older into teenage years and it has specific clinical and biomechanical manifestations [2]. These children generally demonstrate tightness in hamstrings especially the medial hamstrings, hip flexors and adductors, muscle tightness, weakness and spasticity, skeletal deformities, and motor control deficits [3]. Walking with a crouch gait increases the energy costs of walking [4] and can lead to joint pain and degeneration. Further, without intervention, crouch gait typically worsens over time [5, 6].

Mulligan techniques have been widely used in adults to decrease tightness of hamstrings, adductors and rectus femoris. The techniques of bent leg raise have been used to

increase the range of straight leg raise in adults and increase flexibility of hamstrings [7]. Though Mulligan techniques are currently not widely applied in treatment of cerebral palsy, it may show great potential in improving movement and range of motion in children with cerebral palsy. The purpose of the study is to evaluate the effect of three Mulligan techniques adductor elongation, bent leg raise and rectus elongation on mobility of the joint and extensibility of the muscle tissue in children with diplegic spastic cerebral palsy with crouch gait

2. Methods

2.1. Study Design

A prospective study of 12 weeks of Mulligan treatment was conducted from February 2014 to May 2014 (Figure 1). Participants were recruited from the Chembur centre of SNEH RERC, Mumbai, India. The subjects were given treatment using three Mulligan techniques adductor elongation, bent leg raise and rectus elongation for 1 hour for 3 times a week for 12 weeks. All subjects were reassessed after 12 weeks.

2.2. Participants

Four subjects with diplegic spastic cerebral palsy with crouch gait in the age group of 15 years to 25 years were recruited in the study. Children with GMFCS level 1-2 and with healthy skeletal structure suitable for mobilisation based on normal vitamin D and calcium values, normal X-ray, no history of fractures and no associated metabolic conditions were chosen for the study. Children who received gait correcting orthopaedic surgery in past 2 years, botox in past 2 years and those with any other neuromuscular diseases except cerebral palsy were excluded from the study. Similarly, children with GMFCS levels 3,4,5 and those with unstable and weak skeletal structure based on a history of fragile fractures, low vitamin D/calcium levels and metabolic disorders were excluded.

2.3. Ethical Review

Written consents were obtained from all participants. The study was approved by the scientific committee of Certified Mulligan Practitioner's Conference (CMPCON 2014), Navi Mumbai. The study was carried out between February to May, 2014 for a period of 12 weeks.

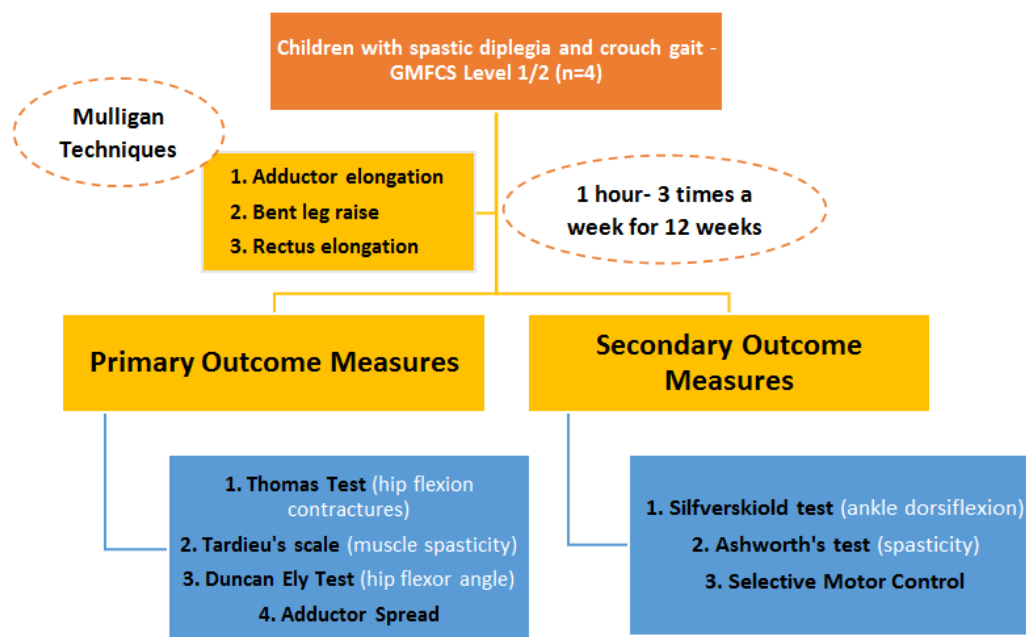


Figure 1. Study Design.

2.4. Intervention

All 4 subjects with Gross Motor Functional Classification Scale (GMFCS) level ½ and their parents were explained about the study and the techniques to be administered as part of therapy and informed consent was taken from the parents. On day 1 and after 12 weeks' subjects were assessed for the primary and secondary outcome measures.

The primary outcome measures included following tests:

Thomas Test was used to measure hip flexion contracture or to measure the length of the muscles involved in hip flexion. [8, 9] Tardieu scale was used to assess the response

of muscle to various grades of stretch applied to the muscle. In short it helps assess the muscle spasticity. Duncan Ely Test was used to measure rectus femoris dysfunction and or femoris spasticity. [10] Adductor spread and Tardieu's scale for hamstrings was used to measure popliteal angle or functional mobility. [11]

The secondary outcome measures included following tests: Silfverskiold test was used to measure the normal ankle dorsiflexion. [12] Ashworth's test was used to measure the resistance for limb movement for iliopsoas, hamstrings, tendo-achilles. [13] Selective motor control was used to assess the ability to move hip, knee and ankle joints

irrespective of posture. [14]

The intervention included three sets of bent leg raise technique administered by therapist on both lower extremities without any assistance from caregiver. The second technique of adductor elongation was administered on both lower extremities simultaneously with the use of belt. This technique on second lower extremity was administered either by the caregiver or by assistant therapist. The third technique of rectus elongation was administered with the help of the assistant therapist who would stabilise knee to the chest and therapist would give traction to the offending extremity with use of belt. Caregiver would stabilise the pelvis avoiding compensatory movements from it during hip extension. The participants were called thrice a week with each session comprising one hour during which three sets of each technique was administered. The caregiver and an assistant therapist were available during administration of these techniques and were taught to administer the technique before starting the study. Following this intervention, strengthening protocol of antagonists of the elongated muscles and muscles of lower extremity and trunk was followed. This included strengthening of obliques, trunk extensors, hip extensors, abductors, ankle plantar flexors and foot intrinsic.

These treatment sessions were delivered for 12 weeks comprising of total 36 treatment sessions in the manner described above. After the completion of these 36 sessions, these participants again underwent a physical re-examination covering the previously tested parameters.

2.5. Statistics

Mean measures of both lower extremities were used as representative values to ensure statistical independence. [15] The paired t-test was used to mean values in pre-and post-sessions. The p values <0.05 were considered significant and those <0.01 were considered highly significant.

3. Results and Discussions

The demographic characteristics of the participants are given in table 1. Mean age of participants was 18 ± 4.8 years (range 15-25 years) with all of them coincidentally being males.

Table 1. Demographic characteristics of the subjects.

Parameters	
Number of Subjects	4
Mean Age (years)	18 ± 4.8 years
Gender	Male
GMFCS Level	$\frac{1}{2}$
Dominance	Left Hand
Type	Right lower extremity weaker than left

In crouch gait, excessive hip and knee flexion with ankle dorsiflexion is associated with decreased range of hip and knee extension. Physical examination of all participants denoted increased tightness of iliopsoas, rectus femoris, hamstrings and adductors. There is a lot of discussion on

lengths of rectus femoris in crouch gait. In this study, the technique of rectus elongation MWM was applied with a target of elongation of rectus femoris and iliopsoas by working on increasing hip extension. However, component of rectus femoris at knee was left untouched in this technique.

This study examined the effects of bent leg raise, adductor elongation and rectus elongation techniques in patients with spastic diplegic cerebral palsy with crouch gait. Significant improvement was noted in length of hamstrings, adductors and rectus femoris after the administration of Mulligan techniques. The right hip adductor spread, Duncan Ely test for right side and Tardieu's Scale (popliteal angle and functional mobility) for left (L1 and L2) and Right (R2) was statistically significant. It is noted that Mulligan techniques showed statistically significant improvement in functional mobility on right side in subjects who had right lower extremity weaker than the left. Therefore, Mulligan techniques have a scope in improvement in functional ability in children with diplegic spastic cerebral palsy with crouch gait.

Table 2. Primary and Secondary Outcomes of the Intervention.

Parameters	Pre (Mean Values in cm)	Post (Mean Values in cm)
Primary Outcome Measures		
1. Thomas Test (Hip flexor angle) [16]		
Right	16	9.3
Left	12	2.3
2. Tardieu's for Hamstrings (Popliteal angle) [17]		
Right R1	77.6	65.6
Right R2 **	57.6	36
Left R1 *	77	69
Left R2 *	57.6	36.3
3. Duncan Ely test (Hip flexor angle measured in prone) [18]		
Right *	11.2	10.1
Left	11.3	9.3
4. Adductor spread		
Right *	30	44
Left	29.3	44.3
Secondary Outcome Measures		
1. Silfverskiold test (Ankle dorsiflexion range) [19]		
Right R1	-1.6	-6
Right R2	12	6.6
Right R3	27	14
Left R1	3.33	-1
Left R2	15.3	5.3
Left R3	28.3	13
2. Ashworth's test [13]		
Iliopsoas Right	2.33	1.33
Iliopsoas Left	2.33	1
Hamstrings Right	3	2.66
Hamstrings Left	3	2.66
Tendo-achilles Right	2.33	2.33
Tendo-achilles Left	2.33	2.33
3. Selective Motor Control [14]		
Hip Right	3	3
Hip Left	3.33	3.33
Knee Right	2.33	2.33
Knee Left	2.66	3
Ankle Right	2	2
Ankle Left	2.33	2.33

Level of significance: *p<0.05 and **p<0.01

The length of tendo-achilles, although not directly targeted in this study, showed improvement ($p < 0.05$). This was noted when measuring Tardieu's of tendo-achilles, which showed R1 (first catch) into plantarflexion rather than in dorsiflexion typically seen in these individuals prior to delivery of these techniques. Improvement was noted in length of tendo-achilles which is of prime importance in patients with crouch gait who typically demonstrate over lengthened tendo-achilles. However, no significant change was noted in tone and selective motor control of hamstrings, rectus femoris and tendo-achilles. There was no significant change noted in selective motor control of hip, knee and ankle. Likewise, there was no significant change noted in Ashworth's score of hamstrings, iliopsoas-rectus, tendo-achilles.

All other measures showed better outcomes but, these were not statistically significant. Larger sample size is required to study the role of Mulligan techniques to improve mobility of the joint and extensibility of the muscle tissues in children with cerebral palsy.

Further studies are warranted with aid of electromyographic data, gait kinetics and in patients with varying levels of GMFCS. Larger sample size and female subjects could be included in the study to assess the gender variance in the effect of treatment.

4. Conclusions

Mulligan MWM techniques (bent leg raise, adductor elongation and rectus elongation techniques) shows potential in improvement in mobility at joints in children with diplegic spastic cerebral palsy with crouch gait, thereby facilitating improved function. Further long term research is warranted in this area.

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