

# Effectiveness of Modified Bamboo Knee Orthosis (Gaiter) on Knee Flexor's Spasticity in Children with Spastic Cerebral Palsy

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## ABSTRACT

**Background:** Spastic cerebral palsy (CP) is the most common type of cerebral palsy. Up to 80% of all individuals with cerebral palsy suffer from some degree of spasticity. Spasticity adversely affects muscles and joints of the extremities, causing abnormal movements, and it is especially harmful in growing children. Several methods have been developed and used to assess spasticity. The most commonly used test in clinical practice is the Modified Ashworth Scale (MAS). The test is based on the assessment of resistance to passive stretch of muscle group at one no specified velocity.

**Objective:** The objective of this study was to investigate the effectiveness of Modified Bamboo Knee Orthosis (Gaiter) on knee flexor's spasticity in Children with Spastic Cerebral Palsy.

**Participants:** Twenty children with spastic cerebral palsy.

**Main Outcome Measure:** Before and after treatments lower-extremity spasticity was measured by Modified Ashworth Scale Bohannon (MAS-B).

**Results:** The mean MAS of left leg before application of Orthosis was 2.00(±.50) and reduced significantly to 1.08(±.52) after treatment whereas the mean MAS of right leg before application of Orthosis was 2.03(±.58) and reduced significantly to 1.10(±.58) after treatment.

**Conclusion:** The Modified Bamboo Knee Orthosis (Gaiter) can be considered as a new, effective, environmental friendly and low cost method for treatment of Knee Flexor's Spasticity in Children with Spastic Cerebral Palsy.

**Key words:** Modified Bamboo Knee Orthosis, Gaiter, Spastic Cerebral Palsy, Knee Flexor's Spasticity, Modified Ashworth Scale.

## INTRODUCTION

Cerebral palsy (CP) is defined as a clinical syndrome characterized by a persistent disorder of posture or movement due to a non-progressive disorder of the immature brain.<sup>[1]</sup> The prevalence of CP is 2 to 2.5 per 1,000 live births<sup>[2]</sup> and its incidence may be increasing secondary to improved care in neonatal intensive care units and improved survival of low birth-weight infants.<sup>[3]</sup> Most children with CP will have spasticity as the main motor disorder and it can be classified either

according to which body areas is affected: hemiplegia, diplegia, tetraplegia, or the movement disorder type: spastic, athetoid, ataxic and hypotonic cerebral palsy.<sup>[2-4]</sup> Spasticity is a major challenge for rehabilitation of children with cerebral palsy. Spasticity can prevent or hamper function, cause pain, disturb sleep, cause unnecessary complications and present major difficulties for care workers.<sup>[5]</sup>

The goal of Orthosis is giving for walking in realistic function. So far ambulation training function is needed to

support at knee and around to prevent contracture and hyper extension of knee.

Casts, splints, and orthoses are all devices that are designed to keep the body in a certain position. These devices are used to prevent or correct deformities in the spastic limb and/or to help children with cerebral palsy overcome activity limitations, such as difficulties with standing and walking. [6,7]

A modified Bamboo knee Orthosis (Gaiter) was developed from locally available bamboo piece, cotton cloth and with Velcro. There have been many designs of the knee gaiters, which differ from the one we have used.

The Aim of the study was to design and fabricate the modified Bamboo knee orthosis for the reduction of knee flexor's spasticity, to stabilize the spastic knee and to prevent the knee flexion contracture in CP children. This study will help to find out the efficiency of modified Bamboo knee Orthosis (Gaiter) in management of CP diplegic.

## METHODS

### Subjects:

A sample of convenience of 20 (10 females and 10 males) patients ranging in age from 3 to 10 years with knee flexor's spasticity took part in this study. The patients with knee flexor's spasticity were treated with modified Bamboo knee Orthosis (Gaiter). The anthropometric data were collected from the patients with the help of their parents. A detailed explanation of the study was given to all the parents, after they signed on an informed consent form. The patients were instructed to wear the knee gaiter as much as possible or about 14 hours/day, including nighttime. The knee gaiter was taken off every 1 to 2 hours for exercises and hygiene care.

Modified Bamboo knee orthosis (Gaiter):

- For fabricating the orthosis patient (subject) should be in standing / lying on the examination table.

- **Only four measurements are needed**
  - Circumferential measurement around mid of thigh.
  - Circumferential measurement below maximum calf.
  - Circumference of knee.
  - Length measurement from mid of thigh to below maximum calf.

**Assessment:** The subjects were assessed and the Modified Ashworth Scale Bohannon (MAS-B) was taken for knowing the effectiveness of the orthosis. One of most important tests in rehabilitation for physical examination of spasticity is the Ashworth scale. Always test the patient while he or she is in a relaxed supine position.

The spasticity was evaluated before using the orthosis and the new evaluation has done after 10 to 12 weeks of using the modified Bamboo knee Orthosis (Gaiter).



### Modified Ashworth Scale of muscle spasticity: (Scoring taken from Bohannon and Smith, 1987):

- 0 No increase in muscle tone
- 1 Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the effected part(s) is moved in flexion or extension
- 1+ Slight increase in muscle tone, manifested by a catch, followed by a minimal resistance throughout the remainder (less than half) of the ROM

- 2 More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
- 3 Considerable increase in muscle tone, passive movement difficult
- 4 Affected part(s) rigid in flexion or extension

**Statistical Analysis:**

Descriptive statistics like mean, standard deviation and percentages were calculated. Wilcoxon signed rank test was used for comparison between pre and post-treatment spasticity as measured by MAS for both right and left leg. Level of significance was set at  $p < 0.05$ .

**Table 1: Data Comparison Before and after wearing the modified Bamboo knee Orthosis.**

Sl. No.	AGE	SEX	MAS-B I		MAS-B II	
			Left leg	Right leg	Left leg	Right leg
1	4	M	1	1.6	0	0
2	5	M	1.6	2	1	1
3	7	M	2	1.6	1	0
4	4	F	2	3	1	2
5	6	F	2	2	1	1
6	10	F	2	3	1	1.6
7	8	M	2	2	1	1.6
8	3	M	2	1.6	1	1
9	8	F	1.6	1.6	1	1.6
10	3	M	2	1.6	1	1
11	5	F	3	2	2	1
12	6	M	1.6	1.6	0	0
13	4	F	2	2	1	1.6
14	7	F	2	3	1	2
15	7	F	3	2	2	1
16	9	M	1.6	2	1	1
17	4	M	2	2	1.6	1.6
18	4	F	3	2	2	1
19	3	M	1.6	2	1	1
20	5	F	2	2	1	1

MAS-B Scale 1+ = 1.6 for the calculation

MAS-B I - Measurement scale of spastic grading of CP Patient before using the orthosis

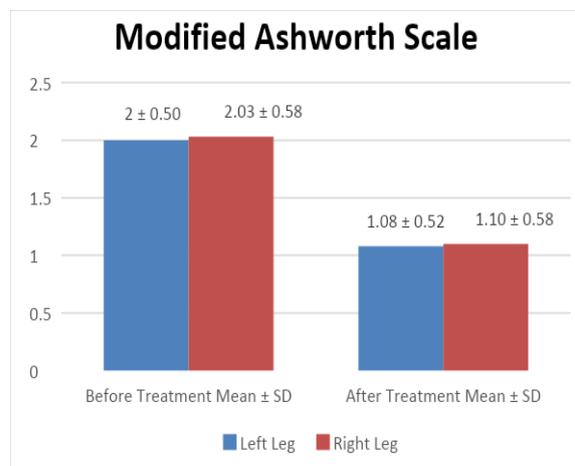
MAS-B II - Measurement scale of spastic grading of CP Patient After use of orthosis

**Table 2: Comparison of pre and post intervention values**

Modified Ashworth Scale (MAS)	Before treatment			After treatment			Wilcoxon	
	Mean±SD	Max	Min	Mean±SD	Max	Min	z	p
Left leg	2.00 ± 0.50	3	1	1.08 ± 0.52	2	0	-4.089	.000
Right leg	2.03 ± 0.58	3	1.6	1.10 ± 0.58	2	0	-3.892	.000

**RESULTS**

The spasticity was reduced from  $2.00 \pm 0.50$  to  $1.08 \pm 0.52$  in the left leg ( $P < 0.05$ ) and from  $2.03 \pm 0.58$  to  $1.10 \pm 0.58$  in the right leg ( $P < 0.05$ ) after 10 to 12 weeks of using the modified Bamboo knee Orthosis (Gaiter). The comparison of post intervention values showed a significance differences in all the factors. So, this result stated that the Modified Bamboo knee Orthosis (Gaiter) has good effect on reduction of Knee Flexor's Spasticity in Children with Spastic Cerebral Palsy.



**Figure 2. Comparison of the improvement in reduction of the Knee Flexor's Spasticity in the left leg and right leg.**

## DISCUSSION

The Bamboo Brace is a dynamic elbow splint for children with special needs that encourage extension of the elbow at more favorable angles in order to learn gross and fine motor skills as well as prevent undesired oral/facial interaction. [8] The Bamboo Brace is sold with 5 flexible and interchangeable support stays of varying resistance. There are 4 different size options which fit children from as young as 2-3 months up to about 18 years of age.

As a rehabilitation tool, The Bamboo Brace is excellent for both cases of spasticity (i.e. cerebral palsy) and weakness (i.e. low muscle tone, Down syndrome). In both situations, the dynamic re-alignment of the elbow assists children in gaining strength and control of key joints and musculature that are critical to the development of gross and fine motor skills. Although The Bamboo Brace can be worn over clothing, the non-slip surface on the inside of the brace is more effective when it is in direct contact with the child's skin.

But the Modified Bamboo Knee Orthosis (Gaiter) is locally made, simple to fabricate and can be reused. It is effective for reducing Knee Flexor's Spasticity in Children with Spastic Cerebral Palsy.

The compliance of Knee Orthosis use is good. The patients can tolerate the pressure and be a part of the active treatment program. The result was found good in all the cases after the use of Modified Bamboo Knee Orthosis (Gaiter). All the subjects had undertaken locomotion/gait training inside the parallel bar. It is important to instruct the parents to take the orthosis off regularly for exercise program. The total time of using the knee orthosis per day varied among the patients.

## CONCLUSION

The Modified Bamboo Knee Orthosis (Gaiter) is a new, effective, environmental friendly and low cost method for treatment of Knee Flexor's Spasticity. Hence it can be concluded that, the

Modified Bamboo Knee Orthosis (Gaiter) can be used as an effective knee orthosis for treatment of Knee Flexor's Spasticity in Children with Spastic Cerebral Palsy. However, a further analysis including more number of patients and revision follow up is necessary for generalizing this study.

**Conflict of Interest:** The author does not have any conflict of interest regarding research, authorship and publication of this article.

**Abbreviations:** CP: Cerebral Palsy, MAS: Modified Ashworth Scale

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