Knee Cage versus Long Ankle Foot Orthosis for Genu Recurvatum in Children with Spastic Diplegia, Pilot Study

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Abstract

Background: Children with diaplegia commonly develop knee recurvatum in both lower limbs. Orthotic management can help in controlling the recurvatum as knee cage or ankle foot orthoses (AFO). Purpose: To compare the effect of posterior knee cage and long AFO in management genu recurvatum in children with spastic diplegia. Methods: Six children with spastic diplegia having knee recurvatum in both limbs enrolled in the study, their ages between 4 to 8 years. They were divided randomly into two equal groups; Group (A) received traditional physical therapy program for such cases while wearing knee cage for three months. Group (B) received traditional physical therapy program for such cases while wearing long ankle foot orthoses for three months. Stress X ray was used to evaluate the degree of recurvatum pre and post study. Results: There was no significant difference between both groups regarding right knee recurvatum while there was a significant difference between groups regarding the left knee recurvatum in favor to AFO. Conclusion: From the obtained results it can be concluded that long ankle foot orthoses achieve more improvement of the knee recurvatum when compared with knee cage in some cases.

Key Words: Diplegia, Recurvatum, Long AFO, Knee Cage, Stress X ray.

Introduction

Cerebral palsy (CP) is the most common movement disorder in children **(National Institutes of Health, 2014).** It occurs in about 2.1 per 1,000 live births **(Oskoui, et al., 2013).**

Cerebral palsy is defined as a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain **.(Kent and Ruth, 2013).**

In children with diplegia, the lower extremities are severely involved and the arms are mildly involved. Intelligence usually is normal, and epilepsy is less common. Fifty percent of children with spastic CP have diplegia. A history of prematurity is usual. Diplegia is becoming more common as more low- birth-weight babies survive. Magnetic Resonance Imaging (MRI) reveals mild periventricular leukomalacia (PVL) **(Cans et al., 2007).**

Generally, the walking of children with diplegia is much slower than in able-bodied children, and their choice of velocity is most efficient but in later years their inefficient walk leads to fatigue .Deformities may be mild, not interfering with walking, but if more severe may lead to deterioration of walking**. (Sophie Levitt et al., 2010)**.

Back knee or knee hyperextension is a type of distortion that affects the knee joint causing the knee to bend backward when the person is on a standing position. The recurvatum appearance is brought by the knees that are situated in a hyperextended position. **(Abdelazizand Samir 2011)**

Certain types of knee braces are worn by persons who suffer knee instabilities. If the patient's problem is genu recurvatum with minimal need for mediolateral stabilization, the knee orthosis can be simple and light in weight. The knee brace known in the art as a Swedish knee cage is an example of this type of orthosis. The Swedish knee cage has been used for many years and is good at restricting hyperextension of the knee. **(Djo and Llc.2007)**

.by means of two anterior straps spaced above and below the knee joint and one U-shaped posterior strap held behind the knee joint. The knee cage is a rigid metal frame having a U-shaped bar extending behind the U-shaped anterior strap and a pair of upper and lower uprights on opposite sides of the frame which hold the upper and lower anterior straps. The Swedish knee cage provides a fixed three-point means of support intended to allow almost complete range of knee flexion, while the lateral and medial uprights provide a limited degree of mediolateral stability.**(Djo and Llc.2007)**.

A solid AFO with an anterior calf strap and an anterior ankle strap isthe most versatile orthotic design and is the orthosis most often prescribedfor children at the perambulatory stage, usually between the ages of 18 and24months developmentally .This orthotic provides stability to the ankle andfoot to give a stable base of support for children to stand. This orthosis isreasonably easy for caretakers to apply and is lightweight. (**Freeman Miller 2007).**

Purpose of the study is comparing the effect of posterior knee cage and long AFO in management genu recurvatum in children with spastic diaplegia

Subjects, Instrumentations and Methods

Subjects:

Six CP children with spastic diaplegia, from both genders enrolled in this study. They were recruited from the outpatient clinic**,** Faculty of Physical Therapy, Cairo University. Their ages ranged from 4-8 years chronologically. Their degree of spasticity of lower limbs ranged from 1 to 1+ according to the modified Ashworth scale (MAS). They have External Rotary Deformity Recurvatum or Internal Rotary Deformity.**(Meding et al.,2003)**. And they were able to stand and walk. Children who had any orthopedic surgery during the previous six months were excluded from the study.

This study was approved from the ethical committee, Faculty of Physical Therapy, Cairo University. After clear explanation of the study protocol a consent letters were obtained from the children parents or caregivers.

They were divided randomly through random allocation of odd and even number into two equal groups; Group (A) received traditional physical therapy program for such cases while wearing knee cage during session and in ADL activity. Group (B) received traditional physical therapy program for such cases while wearing long AFO during session and ADL activity. Duration of session 1 hour 3 times per week, all the children in both groups wore the orthoses for 3 months.

Material for evaluation;

Stress X ray was performed for all children to evaluate the degree of knee recurvatum during standing position before starting and after the study.

Procedure

For the long lateral view radiograph, the patient was positioned with the limb of interest in the lateral view that have bilateral genu recuevatum. The knee was kept in full extension, to see the proximal femur, the pelvis was rotated posteriorly 30°-45° without rotating the knee on the study side. Separate lateral view radiographs of the femur and tibia was used to assess the femur and tibia separately. When a separate radiograph of the femur or tibia was obtained, it was important to specify where to center the beam, to better assess the joint orientation of the proximal tibia or the distal femur, the radiograph should be centered on the knee and assess the joint orientation of the ankle or hip, the radiograph should be centered on those joints. **(Hägglund et al.,2005).**

Material for treatment

1-Posterior knee cage

-Take measurement of knee cage according length of child lower limb and circumference of lower limb.

-Child wore the knee cage as long as he stand and walk.

2-Long ankle foot orthosis

-Cast model would take for child for proper alignment foot and ankle, and this cast would send to technicians for AFO fabrication.

-The upper part of AFO would at level of tibialtubrical.

-Child wore long AFO as long as stand and walk.

-Children wore both orthosis 3 months beside physical therapy program then toke measurement to know result.

3-Physical therapy program

-strengthen ex. Hamstring from prone position with free weight a according child could.

-Abdominal ex

-from side sitting to kneeling

-kneeling ex.

-half kneeling ex.

-kneeling to half kneeling to standing

-Squatting

-Step standing

-Single limb support

-Core stability ex

-standing ex

-side standing

-Balance ex from standing with using balance bored

-Walking forward and backward

-Ascending and descending stairs

-Walking in stepper

Statistical Analysis

Statistical analysis was conducted using SPSS for windows, version 22 (SPSS, Inc., Chicago, IL). Paired and unpaired t test was used to compare the tested dependent variable within and between the two groups with the initial alpha level set at 0.05

RESULTS

Demographic data

There were no statistically significant differences (P>0.05) between subjects in both groups concerning age (Table 1).

Table (1): Demographic characteristics of both groups:

	Group A	Group B	Comparison	
	Mean ± SD	Mean ± SD	t-value	P-value
Age (years)	5.33±0.577	5±1.0	0.6123	0.643

SD: standard deviation, P: probability

The pre and post treatment mean ± SD of right knee extension in group A were 192.03±4.27 and 191.73±3.20 respectively, which indicated no significant difference (P = 0.76). On the other side, the pre and post treatment mean ± SD of left knee extension in group A were 191.13±4.10 and 187.87±3.52 respectively indicating that there was a significant difference (P = 0.01).

The pre and post treatment mean ± SD of right knee extension in group B were 193.97±7.87 and 194.0±7.81 respectively, which indicated no significant difference (P = 0.422). On the other side, the pre and post treatment mean ± SD of left knee extension in group B were 204.57±8.0 and 204.53±7.99 respectively indicating no significant difference (P = 0.422).

When comparing the pre-treatment mean values regarding the right knee extension (Degrees) for both groups A and B, There was no significant difference (p= 0.727). Also, There was no significant difference between post treatment mean values of knee extension for both groups A and B (p= 0.66), table (2).

When comparing the pre-treatment mean values regarding the left knee extension (Degrees) for both groups A and B, There was no significant difference (p= 0.06). While, there was a significant difference between post treatment mean values of knee extension for both groups A and B (p= 0.02), table (3).

Table (2): Right knee recurvatum (Degrees) of both groups A and B:

Rt Knee recurvatum	Means ± SD Pre	Means ± SD Post	P- value
Group A	**192.03±4.27**	**191.03±4.27**	**0.757**
Group B	**193.97±7.87**	**194±7.81**	**0.422**
P- value	**0.727**	**0.666**	

*Significant level is set at alpha level <0.05

Table (3): Left knee recurvatum (Degrees) of both groups A and B:

Lt Knee recurvatum	Means ± SD Pre	Means ± SD Post	P- value
Group A	**191.13±4.10**	**187.87±3.52**	**0.013***
Group B	**204.57±8.00**	**204.53±7.99**	**0.422**
P- value	**0.06**	**0.02***	

*Significant level is set at alpha level <0.05

DISCUSION

This study was designed to compare the effect of knee cage versus AFO on genu recurvatum in children with diplegic cerebral palsy.

A diaplegic gait is presentedin the following pattern ,one of this pattern a 'jump gait' of hip and knee flexionwith equinus on initial foot contact followed by hip and knee extension during stance. **(Graham 2004)**.

Genu recurvatum is a consequence of a poor control over the knee joint due to muscle weakness, impaired tonus and deficit in joint proprioception. Uncontrolled locking of the knee during ambulation causes recurrent micro trauma which leads to degenerative changes and instability.**(Abdel Aziz and Somaia2013)**.

The results of the study revealed that, there was significant difference between the two groups regarding the left knee hyperextension in favor to group A, with no significance difference between both groups A and B regarding the right knee hyperextension.

The past treatment results obtained from this study may be due to the asymmetrical affection in both lower extremities in children with diplegic cerebral palsy along with asymmetrical weakness in both lower limbs in such cases.

This come in agreement with ***Heidi et al. (2008***), who stated that" many children with diplegia have asymmetry betweenthe legs of individual weak muscle groups butpelvic asymmetry and scoliosis may not always be present. However, when scoliosis is present, it is dueto unequal weight distribution and/or difference inleg length. There may be limited mobility in hips, pelvis and lumbar spine. Spasticity anddeformity are more in the psoas, hamstrings, rectus femoris and gastrocnemius".

The improvement of left knee recurvatum in group a using long AFO may be due to the effect of AFO on foot and calf muscles through creating dorsiflexion on the ankle and foot which in turn creates flexion on the knee joint hence reducing the degree of recurvatum during stride standing.

This comes in agreement with ***David Patrick, (2007)*** who assumed that AFOs are frequently utilized to improve ambulation status and gait quality. AFOs are capable of controlling the foot and ankle directly and the knee indirectly. For example, by positioning the ankle in dorsiflexion, a knee flexion moment can be produced to control genu recurvatum. Also, positioning the ankle in plantar flexion can produce a knee extension movement to assist in stabilizing the knee.

Also, our results are parallel with ***Miller (2007***) who suggests a calf-length articulated AFO thatlimits plantarflexion to assist hamstring strengtheningover time to counter the knee hyperextension.

Conclusion:

The predominance of statistical evidence presented in this study suggested that both AFO and knee cage was effective for addressing genu recurvatum in children with diaplegia and commonly prescribed to control genu recurvatum in children with diplegia while AFO was superior than knee cage in some cases.

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