The Effects of Botox Injections Combined with Passive Prolonged Stretching and Noncompliance of Caregivers in a 14 Year Old Boy with Spastic Quadriplegia.

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Abstract:

Background and Purpose: Cerebral palsy is a non-progressive disorder of motor function that has associated with neurological body functions and structures, and activities capacities. Muscle spasticity, muscle weakness and limitations in joint range of motion are the most common characteristics. Two of the many therapeutic interventions aimed at reducing spasticity and improving range of motion are stretching and Botox injections. Caregiver compliance and follow through play an important role in successful management of spasticity. This study is aimed at determining the effectiveness of Botox injections and passive prolonged stretching in improving range of motion in an adolescent with spastic quadriplegic cerebral palsy. **Case Description:** The patient addressed in the study was a 14 year old male with a diagnosis of spastic quadriplegia and was receiving Botox injections throughout his bilateral lower extremities, while receiving school based physical therapy. **Outcomes:** Passive, prolonged stretching following Botox injections did not improve range of motion measurements. **Discussion:** The results of the study demonstrate a need for continued research in the effectiveness of Botox injections, and the need for established guidelines for Botox administration. This study also discusses the importance of caregiver compliance with home programs.

Introduction:

Cerebral palsy (CP) is a non-progressive, non contagious condition of motor dysfunction that has associated neurological body functions and structures, and activity capacities of varying degrees.[1,2,3] The diagnosis of CP is attributed to brain lesions and anomalies in early development, occurring in the prenatal, perinatal or postnatal time period.[3,4] Body functions and structures like muscle spasticity, muscle weakness, limited joint range of motion and hyper-reflexia are common characteristics of CP. Additional neuroimpairments, such as mental retardation, visual and learning impairments, seizure disorders, deficits in speech, language and perception, as well as behavioral problems are also common.

CP is diagnosed early in infancy and mostly by observation, failure to meet motor milestones, persistence of primitive reflexes, abnormal muscle tone and abnormal movement.[4] There are two primary ways to classify the diagnosis. The first method of classification is to describe the motor characteristics which are spastic, hypotonic, atheoid, dystonic and the topographical pattern of limb involvement.[4] The second method is to separate the disorder based on the area of brain injury and classify it as pyramidal (spastic) or extra pyramidal (non-spastic) CP. There are four main subtypes of CP: (1) spastic diplegia which involves bilateral lower extremities without neurological signs affecting the upper extremities, (2) spastic quadriplegia which has neurological signs throughout the bilateral upper and lower extremities and often influences on the trunk, (3) spastic hemiplegia where the ipsilateral upper extremity and lower extremity are involved, and (4) mixed CP in which there are ataxic, athetoid, hypotonic or dyskinetic features.[1] The estimated prevalence of CP is between 1.2-2.5 per 1000 live births, with

spastic quadriplegia occurring in 70% of all cases.[1,5] Spastic quadriplegia is the most common form of CP and the subtype associated with the greatest severity of symptoms.

In spastic quadriplegia spasticity, limited joint range of motion and decreased gross and fine motor function are found in all four limbs, with the lower limbs typically more affected than the upper limbs.[1,3] Among babies born full term there are four common etiologies of spastic quadriplegia: hypoxic-ischemic perinatal asphyxia, metabolic disease, structural malformation, and central nervous system (CNS) infection. In preterm infants the etiological spectrum included: periventricular leukomalacia, hypoxic-ischemic perinatal asphyxia and CNS infections.[1,2,4,5] Spasticity, or increased muscle resistance to stretch, is one of the most disabling characteristics of spastic quadriplegia. Increased spasticity leads to limited joint range of motion, abnormal postures, labored and extraneous movement and possible joint contractures. Therapeutic intervention may help manage the secondary effects of spasticity.

Prolonged passive stretching is a therapeutic intervention that is widely used to manage spasticity. Passive stretching is a technique in which an external force is applied to move a muscle or soft tissue into a lengthened position. Prolonged passive stretching is maintaining the muscle in a lengthened position for an extended period of time.[6] The most effective amount of time to maintain a stretch is frequently debated and inconclusive throughout the literature, but a prolonged stretch is defined as maintaining the stretched position for one minute.[6,7] Passive prolonged stretching can be performed manually by a clinician or by mechanical devices such as orthoses, splints, casts and positional devices.[7] The indications for stretching in children with CP are to prevent muscle contractures (adaptive shortening of muscles and soft tissue surround a joint

which result in significant range of motion and functional ability loss), maintain or improve current functional status and improve joint range of motion.[7]

One of the more recent approaches to managing spasticity CP is Botulinum Toxin (Botox) injections. There are several variations of Botox, the one used most commonly and shown to be the most effective in reducing spasticity is type A (BTX-A).[8,9,10,11] BTX-A is injected into selected muscles that have increased spasticity which prevents the release of the neurotransmitter acetylcholine at neuromuscular synapses thus temporarily denervating the muscle resulting in muscle relaxation.[8,9,11] The resulting period of muscle relaxation following injection is said to be 12-16 weeks.[9,11] The clinical uses of BTX-A injections are to relieve pain associated with increased muscle spasticity, improve range of motion, improve mobility in ambulatory patients, improve posture, and increase tolerance to wearing orthoses.[10] Side effects of BTX-A are typically uncommon with careful administration, however, pain at the injection site, temporary incontinence and constipation have be reported.[8,9,11]

Currently there are no established protocols and varying dosage recommendations for BTX-A administration. Dosage recommendations range from 0.5 units per kg of body weight to 1000 units per kg of body weight, depending on the degree of spasticity and the size of the targeted muscle groups.[8,10,11] The literature suggests that the amount of dosage is dependent on the degree of desired muscle relaxation and the therapeutic goals of individual patients.[8,10] Graham et al suggest that Botox injections are most effective in patients that meet specific criteria. They recommend that Botox should be used in patients that have spasticity limited to no more than four muscle groups, in patients who have selective muscle control, no joint deformity or contracture development and they

also recommend injections should be started early in childhood.[8] The researchers suggest that if these conditions are not met, oral therapy, intrathecal baclofen or a selective dorsal rhizotomy may be more appropriate for managing spasticity, especially in the lower limbs. Graham et al also propose that Botox injections be used as a compliment and adjunct to conservative spasticity management, like physical therapy, stretching and positioning through the use of orthotic devices.[8] Likewise, the American Academy of Cerebral Palsy and Developmental and Medicine support the use of Botox injection in combination with traditional means of intervention, rather than its use alone.[12]

The therapeutic effects of Botox last about 12-16 weeks, before new synapses are formed allowing acetylcholine to be released and absorbed across neuromuscular junctions, which signal muscle contraction.[8,11] During this 12-16 week period of muscle relaxation, therapeutic interventions should be implemented to gain improvements beyond the effect of the injection.[8,12] Physical and occupational therapists can develop plans of care that are appropriate for improving range of motion, muscle length and will provide the most functional carry-over following injection. Orthoses are commonly used in combination with physical or occupational therapy to place muscles in a stretched position for a prolonged period of time and to encourage proper biomechanical positioning.[8,11,12] The literature suggests that the greatest outcomes are seen in patients receiving Botox injections for the management of spasticity when it is used in conjunction with conservative treatment approaches like prolonged stretch and the use of orthoses.[8,9,10,11,12]

Caregiver compliance is another factor to consider in a patient receiving Botox injections. Parental and caregiver involvement in intervention strategies, whether

traditional, alternative or conjunctive, has been shown throughout the literature to improve outcomes and accelerate the accomplishment of goals established by physical therapists.[13] Likewise, caregiver non-compliance and poor adherence to established home care, positioning or bracing recommendations have been linked with negative outcome and lesser gains.[7,13]

Compliance is defined as the degree of concordance between patient or caregiver's behaviors and suggestions of health care providers, and the adherence to recommendations.[14] It is difficult to measure and a patient is typically considered to be compliant with recommendations if positive outcomes are seen or therapeutic recommendations are followed at least 80% of the time.[14] Caregiver or patient compliance is influenced by a wide variety of variables including, but not limited to, socioeconomic factors, religious observances, psychosocial issues, severity of disease process, self image and complexity of therapeutic recommendations. The literature suggests that compliance is increased if recommendations are easily incorporated into one's daily routine, and when self-image, self-esteem and attitude about the treatment are positive.[14] Currently, there are limited tools available to measure compliance with therapeutic recommendations, especially as it relates to bracing and orthotic use. The success of bracing and orthotic device use is primarily dependent on compliance and acceptance.

The purpose of this study was to determine the effectiveness Botox injections in combination with passive prolonged stretching in a 14 year old boy with spastic quadriplegia CP, in improving bilateral lower extremities muscle length and range of motion. The second purpose was to determine if therapeutic intervention could be

effective with limited caregiver compliance or home follow through. This research has been approved by the Institutional Review Board at The Sage Colleges in Troy, NY.

Case Description:

The patient is a 14 year old boy with a diagnosis of Spastic Quadriplegia. He has additional diagnoses of global developmental delays and asthma. He has a significant past medical history including a selective dorsal rhizotomy, bilateral inguinal hernias, right hip displacement and cocaine toxicity at birth. He has not undergone any recent surgeries or hospitalizations. He was receiving Botox injections in multiple locations throughout the bilateral lower extremities (Table 1).

The patient is currently receiving school based physical therapy twice a week, individually, as mandated by his Individualized Education Program (IEP). The patient receives physical therapy services throughout the summer school session as well. He has a classroom aide that assists him with all academic activities and activities of daily living. In addition to physical therapy, occupational therapists work with this patient two times a week, individually, to maintain upper extremity joint range of motion, prevent the development of contractures and monitor elbow and wrist splints to detect the development of pressure sores. The goal for occupational therapy services is to improve his tolerance, and caregiver adherence to wearing splints. The patient receives speech therapy services 3 times a week, once individually and twice in a group, to improve function in the classroom and work towards communicating with an assistive communication devices, like a Dynovox, with hand over hand assistance to answer simple choice questions.

The patient lives with his adoptive parents and his younger brother who also has multiple diagnoses. Spanish is the primary language spoken in the patient's home, and communication is difficult. His parents are inconsistent with positioning and bracing recommendations. Prior to the start of the study the patient's braces and abductor pommel were sent to school with him in a separate bag, and then placed on him by the physical therapist or classroom aide at the start of each school day. The patient was sent home with notes from the classroom teacher, aide and physical therapist asking the parents if they would like to come into school for bracing and pommel placement demonstrations and instructions. The notes came back to school with the patient unanswered. At the beginning of the summer session of school, the patient's braces and pommel were not longer sent into school with him.

This patient was chosen for this study based on convenience and the interest of the author to examine the effect of the combination of Botox injections and stretching, on a young man with multiple systems and diffuse muscle involvement.

Examination:

History: A full medical history was obtained using a review of the patient's student file, which included the student's Individualized Education Plan (IEP), a referral from the patient's doctor for physical therapy services which listed and explained the patient's diagnoses, birth and social history and listed past and recent medical interventions. The patient presented with significant increased muscle tone of both the bilateral upper and lower extremities. He had increased muscle tightness and joint contractures of bilateral shoulders and wrists, and wears bilateral wrist and elbow splints intermittently and inconsistently throughout the day. He has decreased range of motion

throughout all joints of his lower extremities, especially hips and knees. The patient has bilateral ankle-foot orthoses which are intermittently and inconsistently used throughout the day. Due the nature of his multiple diagnoses the patient is non ambulatory and requires a manual wheelchair for mobility. The patient has a customized wheelchair with additional features to assist with proper alignment. An abductor pommel has been added to the wheelchair to help correct alignment of the lower extremities, since the patient is windswept to the right. However, the pommel was removed by the patient's caregivers, as it was reported to make transfers difficult. He has no functional use of his upper or lower extremities and is dependent on caregivers for all self care. The patient is able to roll from sidelying to supine by extending, or arching his back. He cannot roll supine to prone. He cannot maintain balance while sitting, and needs moderate to maximum support to maintain this position. He has a tendency to lean backwards while seated, and has no balance or postural reactions to correct his body before falling. The patient is unable to stand with or without assistance. His left leg is internally rotated and adducted due to the severity of his windswept legs to the right, which makes it difficult for him to weight bear throughout his lower extremities. He requires maximum assistance during transfers, and needs two people to lift him from his wheelchair or the use of a mechanical lift (hoyer). The patient is non-verbal and communicates using assistive technology, eye gaze, simple vocalizations and smiles.

Systems Review:

The patient's cardiopulmonary system was not assessed for the purposes of this study. He did not demonstrate signs of distress during physical therapy interventions. An integumentary screen performed at baseline and at regular intervals throughout the study,

revealed a red area surrounding the patient's left hip. This red mark was suspected to be a result of pressure and irritation from the seatbelt of the wheelchair, which would have been prevented if the abductor pommel was worn consistently to maintain correct positioning of his windswept lower extremities. Red areas were also seen near the bilateral lateral malleloi when the patient arrived at school without ankle foot orthoses and sandals on his feet. The sandals were removed and socks were placed on the patient's feet during these situations. The patient has significant limitations in range of motion of his lower extremities and increase muscle tone throughout.

Tests and Measures:

1. The Modified Ashworth Scale (MAS) was used to determine the patient's degree of muscle tone. The MAS is a simple 6 point rating scale used to measure muscle tone, or the resistance of a muscle to stretch or passive elongation, 0 indicates there is no increase in muscle tone, 5 indicated the limb being tested is rigid. It is the most common, non invasive tool used to measure spasticity in the extremities. The literature has varying reports of reliability and validity on the MAS and its use in measuring spasticity in the lower extremities.[15,16,17] (Table 2).
2. Joint range of motion was measured using a goniometer. A goniometer is a measurement tool used by physical therapists to assess the available range of motion of a joint. A goniometer is a reliable and valid tool for measuring joint range of motion and muscle length.[18] A plastic 12 inch, 360° goniometer was used to measure the patient's range of motion in the following directions bilaterally, hip flexion, hip abducton, hip adduction, hip internal rotation, hip external rotation, knee flexion, and knee extension. Measurements were taken twice

throughout the course of the study, once at baseline, and once again at the completion. (Table 3).

3. Sitting balance and postural reactions were assessed while the patient was seated on a mat table. The patient was unable to sit independently and did not demonstrate postural righting reactions or protective reactions.
4. Bed Mobility and Transfers: The patient is able to roll from sidelying to supine by extending or arching his back, but is dependent in all other forms of bed mobility. He requires maximum two person assistance for transfers or the use of a mechanical lift.

Evaluation: The patient is a 14 year old male with a diagnosis of Spastic Quadriplegia. Upon evaluation he presented with decreased range of motion and increased muscle tone throughout his bilateral lower extremities, as well as, decreased balance and ability to transfer.

Diagnosis: Primary Diagnosis: According to the *Guide to Physical Therapy Practice* the patient falls into Preferred Practice Pattern, 5C: Impaired Motor Function and Sensory Integrity Associated with Non-Progressive Disorders of the Central Nervous System- Congenital Origin or Acquired in Infancy or Childhood.[19]

Prognosis: Based on the patient's degree of muscle involvement, the prognosis for Botox injections and prolonged passive stretching to improve lower extremity range of motion is fair.

Short Term Goals and Long Term Goals:

1. The patient will tolerate developmental positioning for 30 minute intervals without increase in negative behaviors or pain, 80% of the time, as measured by therapist observation in one year.
2. When measure with a goniometer, the patient with maintain or improve passive range of motion of bilateral lower extremities by 5-8 degrees, measured once every 10 weeks.
3. The patient will tolerate being positioned, in various equipment, other than his manual wheelchair, for blocks of at least 30 minutes, 2-3 times per day.

Plan of Care: The patient was scheduled to be seen twice a week for 30 minute sessions over a course of six weeks for positioning and passive prolonged stretching.

Interventions: Physical therapy interventions were focused on increasing the tolerance to developmental positioning, specifically supine, prone and seated, as well as stretching and myofascial release to improve muscle length and range of motion and prevent the development of contractures (Table 4). Treatments interventions including positioning patient in supine on mat table, gentle rocking of his lower extremities for relaxation and lower extremity stretching of hamstrings, hip internal and external rotators and adductors. Gentle rocking was introduced prior to stretching to induce generalized relaxation throughout the patient's body. The patient's knees were bent to 90 degrees and gently moved side to side for 5 minutes before passive stretching was performed to each muscle group. The patient was placed in supine on mat table with large wedge and pillow behind head and back and a passive prolonged stretch to bilateral hamstrings, adductors, abductors, internal and external rotators performed by student physical therapist. Each

position was held for 1 minute then slowly released and repeated twice on each muscle group. The patient was placed prone over a large therapy ball during one session to allow for gravity assisted range of motion improvements. Gravity was used to allow for relaxation and passive elongation of bilateral hamstrings for 10 minutes. Patient was then placed in supine over ball to allow gravity to passively stretch and elongate bilateral hip flexors. The ball was gently rocked side to side encourage relaxation.

Daily notes were sent home to the patient's caregiver requesting that the pommel was placed on his wheelchair each morning and that his braces were sent to school with him, if they were not placed on him in the morning. Instructions on proper pommel placement and the correct method to don and doff braces were included in the daily notes. Invitations for educational opportunities for proper transfer methods were also sent home weekly with the patient. The patient arrived to school each day without his wheelchair pommel or bilateral AFO's, and a note came from the caregiver's denying the need for instructions on bracing, pommel placement or transfers.

Outcomes: The patient was treated for a total of 8 times over the course of six weeks. He was absent from school one day, and not seen secondary to school wide activities on another day. The patient's range of motion measurements did not significantly improve over the course of the study, most likely due to caregiver non compliance, improper positioning, inconsistent and minimal orthotic use and physical therapy services being provided only twice a week. The patient did not make progress on the range of motion goal established for him, his range of motion worsened (Table 3). The bilateral lower extremities appeared to become more windswept and adducted without the consistent placement of the adductor pommel on the wheelchair. Also, although ankle range of

motion measurements were not objectively assess through goniometric measurements, it was observed that the patient's bilateral ankles were developing a plantar flexed, inverted synergy pattern. He was able to accomplish his goal of increasing his tolerance to developmental positioning in various positioning equipment for 30 minute intervals. The long term prognosis for range of motion and muscle length improvements is poor.

Discussion:

Botox injections for treating spasticity associated with CP have been reported in the literature as a successful adjunctive treatment to physical and occupational therapies. The goals of Botox injections are to improve a person's tolerance to bracing and positioning schedules, improve joint range of motion, reduced pain associated with spasticity and prevent the development of contractures.[10] Botox injections are used on a variety of patient populations with varying degrees of spasticity. These variations make it difficult to develop a protocol for injection administration and make it difficult to determine the patient population for which injections will be most effective. Botox injections have been suggested to be most effective when started early in childhood and before contractures have developed.[8,12] Other recommendations for effective outcomes with injections are to use Botox in people with spasticity affecting few, localized muscle groups, in people with the ability to move and control limbs, and in people who do not have contractures or deformity.[8] The effectiveness of Botox is furthered by physical and occupational therapies which incorporate interventions to increase muscle length and biomechanical alignment. The purpose of this study was to determine if Botox injections were effective in improving muscle length in an adolescent with CP. However, the patient addressed in this study did not show range of motion improvements after a course

of Botox injections and physical therapy interventions, indicating that he may not have been an appropriate candidate for Botox based on the recommendations in the literature.

There are three possible reasons for the lack positive outcomes seen with this patient receiving Botox injections and physical therapy. The first is that the patient's degree of spasticity was too severe and diffuse to see significant gains in range of motion. Prior to receiving Botox therapy the patient presented with significant range of motion limitations and increased muscle tone throughout the bilateral lower extremities. Graham et al suggest that if four or more muscle groups have increased spasticity the use of Botox becomes less applicable and alternative means of tone reduction, like oral therapy, intrathecal baclofen and selective dorsal rhizotomy, should be considered.[8] The patient has received a selective doral rhizotomy prior to receiving Botox therapy. A selective dorsal rhizotomy is a surgical procedure that is commonly used as a treatment for reduction of moderate to severe lower extremity spasticity, by selectively cutting dorsal nerve roots from the spinal cord segments.[20,21] The patient presented in this study had greater than four muscle groups involved, even following a procedure like a selective dorsal rhizotomy, demonstrating that he may not have been an appropriate candidate for Botox injections.

The literature also suggests that positive outcomes following Botox injections in children with a classification of levels III and IV on the Gross Motor Functional Classification System (GMFCS) are harder to obtain.[8,9,12] The GMFM is a classification system specifically for people with CP that measures gross motor function. The GMFCS is a five level classification system which vary from level I (no restrictions in mobility) to level V (self mobility is severely impaired, even with the use of technology).[4] The patient

presented in this case is classified as a level V, further indicating that he was an inappropriate candidate for Botox therapy.

The second reason for limited outcomes might be that the patient was only treated for eight physical therapy sessions over a course of six weeks, which may not have been intense enough to see significant gains in range of motion through passive stretching. Regular, prolonged stretching in children CP is crucial to maintaining full range of motion and preventing contractures.[20] Stretching and physical therapy interventions are needed to see increases in range of motion measurements and muscle length especially because the effects of Botox are short term.[8,11,12] Botox reaches its peak relaxation effect around 6-12 weeks following injections, during this time, therapeutic interventions are most important. This patient was seen for physical therapy immediately following his course of injections, as mandated by his IEP. He received PT within the appropriate time frame. However, he may not have received adequate time spent in PT to result in positive outcomes. It is recommended that children with CP receive 30-60 minutes of PT interventions for 5 days following injections, in combination with proper positioning and bracing to see the greatest outcomes beyond the effects of the Botox injections alone.[8,12,20]

Proper bracing and positioning are important for successful outcomes in patients with CP. They maintain proper biomechanical alignment of joints, prevent contractures and deformity, and improve range of motion.[7-8] The use of orthoses is an essential part of therapeutic interventions following Botox injections. Orthoses provide an effective sustained stretch to muscles and keep them in a lengthened position for a significantly longer time period than what can be performed through manual stretching by a therapist.[8]

Research supports that sustained stretching, through external devices like orthoses, is more effective at improving range of motion in children with CP than passive prolonged stretching.[7] The patient addressed in this study may have shown greater range of motion outcomes if his parents were consistent with bracing recommendations.

The third and possibly most important reason for lack of outcomes was that there was limited caregiver follow-through with proper positioning and bracing. Research has shown that involving parents in intervention programs have yielded successful outcomes.[13] Parental involvement and compliance with interventions established by physical therapists has been shown to accelerate the achievement of related goals. The parents of the patient discussed in this study were not active participants in his therapeutic interventions or in the creation of his physical therapy goals. They were inconsistent with bracing and positioning recommendations and dressed the patient in inappropriate footwear, like sandals. They refused assistance and denied educational opportunities for instruction on donning and doffing ankle-foot orthoses and removing the pommel of his wheelchair for easier transfers.

There are a few possibilities for the lack of caregiver compliance with this particular patient. As mentioned in the introduction, compliance is increased if therapeutic recommendations are seen as positive. The parents of this adolescent may have viewed the bilateral orthotic devices and wheelchair pommel negatively and associated it with a negative image, possibly thinking it made their child appear more disabled. This perceived threat to body image increases the likelihood of noncompliance.[14] Additionally, the recommendations may have interfered with the family's daily routine thus resulting in non-compliance. Again, the success of bracing and

positional devices are dependent on the compliance of caregiver putting them on and the patient wearing them for the recommended period of time.

Perhaps the caregivers of this patient should have been screened using a tool to assess their likelihood to follow therapeutic suggestions prior to the patient receiving Botox injections or using bracing devices. Currently there are no established tools, to the knowledge of the author, to measure the likelihood of compliance to bracing and positioning recommendations after Botox injections. Perhaps such a tool should be developed to help determine if a patient will have successful outcomes based on their level or their caregiver's level of predicted compliance. This may have assisted in determining if Botox injections were going to be beneficial to managing the spasticity of the patient presented in this study, or if another intervention would have been more appropriate.

An established device used to measure actual levels of compliance to orthopedic bracing, the compli-o-meter, may have been an interesting tool to use with this patient and his caregivers.[14] The compli-o-meter is an external device that was developed to objectively measure the compliance and wear time of braces for teenagers with idiopathic scoliosis. The device records when the orthopedic brace is worn and removed, whether the brace has been positioned properly and the number of minutes per hour it is worn.[14] It was shown to a reliable tool for measuring actual wear of braces and to be a successful way to help improve adherence to bracing recommendations for patients with idiopathic scoliosis. If the compli-o-meter could be adapted to fit on ankle foot orthoses, it possibly may have aided increasing the compliance to bracing suggestions for the patient presented in this study, by objectively showing the caregivers that they were not meeting

the recommended amount of bracing wear time. However, this may have not be feasible due to high cost of the compli-o-meter and the unknown reliability of such a device used with a different type of brace other than the kind it was studied on.

The patient presented in this study may benefit from alternative, more invasive procedures to improve his range of motion limitations, prevent contractures, decrease pain and make transfers and self care easier for his caregivers. The patient may benefit from intrathecal bacolfen injections or muscle tendon releases. Intrathecal baclofen injections deliver the tone reducing drug, Baclofen, to the intrathecal space, or the innermost membranes of the spinal cord.[20] This could help reduce muscle tone throughout the muscles of the lower extremities. Muscle-tendon releases could also be beneficial to this patient. Muscle-tendon releases consist of recession of tendons to improve function by correcting joint malalignment or contracture development.[22] Muscle tendon releases have been shown to improve function and pain associated with restricted range of motion. This patient may be a good candidate of muscle tendon releases due to the severity of this muscle spasticity and his inability to be functionally weight bearing.

This study demonstrates that Botox injections in combination with passive prolonged stretching may not be effective in patients with increased muscle tone throughout their body or in patients with non compliant caregivers. The study also demonstrates the need for establishing protocols for determining appropriate candidates for Botox injections, which take into account the degree of spasticity, number of muscle involvement and the patient and/or caregiver’s ability to adhere to bracing and positioning recommendations established by doctors or therapists.

Conclusion:

Cerebral palsy is a non-progressive disorder, caused by an injury to the brain around or during the time of birth, which results in abnormal motor control. Spasticity is a primary characteristic of CP and is the main cause of impaired function in children. There are many therapeutic interventions for managing spasticity, including stretching, range of motion activities, orthotic use for proper biomechanical alignment, and more recently the use of Botox injections. Botox injections have been determined to be an effective way to reduce spasticity and prevent the development of painful joint contractures in patients with CP of varying degrees. The patient presented in the study, however, did not benefit from Botox injections and did not show improvements in range of motion. This study demonstrated the need for continued research to determine the effectiveness of Botox therapy, especially in patients with diffuse muscle involvement. The study also demonstrates that managing the characteristics associated with CP should be done on an individual basis, and management should be tailored to the type and severity of the disorder, with a focus on family education and guidance. Screening tools should be developed to measure caregiver compliance.

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TABLES

Table 1: Location and Dosage of Botox Injections

Muscle	**Sites within Muscle**	**Dose (units per kg of body weight)**
Right Adductor Longus	4	80
Right Adductor Magnus	4	50
Right Medial Hamstring	3	35
Right Lateral Hamstring	3	35
Left Adductor Longus	4	80
Left Adductor Magnus	4	50
Left Medial Hamstring	3	35
Left Lateral Hmastring	3	35

Table 2: Patient's scores for the Modified Ashworth Scale

Muscle Under Stretch	**Right**	**Left**
Hamstrings	4	4
Adductors	3	4
External Rotators	0	5
Internal Rotators	4	0

Table 3: Pre and Post Intervention Passive Range of Motion Measurements

	Pre Intervention		**Post Intervention**	
Joint Tested	**Right**	**Left**	**Right**	**Left**
Hip Flexion	78 ^{o}	105 ^{o}	89 ^{o}	97 ^{o}
Hip Abduction	10 ^{o}	0 ^{o}	-20 to -10 ^{o}	-27 to -15 ^{o}
Hip Adduction	25 ^{o}	15 ^{o} resting	20 ^{o} resting	27 ^{o} resting
Hip Internal Rotation	0 ^{o}	30 ^{o}	0 ^{o}	60 ^{o}
Hip External Rotation	55 ^{o}	30 ^{o}	80 ^{o}	45°
Knee Flexion	120 ^{o}	110 ^{o}	120 ^{o}	110 ^{o}
Knee Extension	-55 ^{o}	-40 ^{o}	-35 ^{o}	-30 ^{o}

Table 4: Physical Therapy Interventions

Intervention	**7/1**	**7/2**	**7/9**	**7/14**	**7/16**	**7/21**	**7/23**	**7/28**	**7/30**	**8/4**
Passive LE stretching, patient in supine with large wedge behind head	X	X	X	X			X	X	X	
Patient placed over large therapy ball						X				
Gentle rhythmical rocking with knees at 90 degrees			X				X		X	
Patient not seen					X					X