



HealthSouth Rehabilitation Hospital of Austin  
1215 Red River  
Austin, TX 78701

May 6, 1998

Mr. David McMurrey  
Association of Texas Two-Year Colleges  
25 W. 5th Street  
Austin, TX 78705

Dear Mr. McMurrey:

I am submitting the background report, "Cerebral Palsy and Its Treatments," that I agreed to write on February 22, 1998.

The purpose of this report is to provide useful background on cerebral palsy to physical therapy and physical therapy assistant students. It covers a variety of non-physical therapy treatments and then concludes with an in depth look at the role of physical therapists in managing the condition.

I hope this report will be helpful for those students that will soon become licensed physical therapists. If you would like to discuss the report with me please let me know.

Sincerely,

Farah Anathanarayana, M.P.T.  
HealthSouth Rehabilitation Hospital of Austin

Encl.: technical background report on cerebral palsy and its treatments



**Report  
on  
CEREBRAL PALSY AND ITS TREATMENTS**

submitted to  
Dr. David McMurrey  
Association of Two-Year Colleges  
25 W. 5th Street  
Austin, TX 78705  
May 6, 1998

by  
Farah Anathanarayana, M.P.T.  
HealthSouth Rehabilitation Hospital of Austin

This report contains information on the background of cerebral palsy as well as its treatments. The background covers the types, causes and symptoms of cerebral palsy. The treatment sections discuss orthopedic surgery, orthotics, current drug therapies, selective dorsal rhizotomy, speech therapy, occupational therapy and physical therapy. The main treatment focused on is physical therapy.

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## ABSTRACT

Cerebral palsy can be used to refer to any non-curable, non-progressive disorders which affect a child's ability to move and to maintain posture and balance. Its cause is related to the type of cerebral palsy (CP). The four types of CP are spastic, athetoid, ataxic and mixed. Spastic cerebral palsy is characterized by tense, contracted muscles and is the most common form. It results from brain damage in the motor cortex. Athetoid and ataxic CP result from damage to the cerebellum. People with athetosis have constant, uncontrolled motion of their limbs, head and eyes. However, people with the ataxic form have a poor sense of balance which often causes stumbles and falls. Finally, people with the mixed form experience complications of the other three forms. This is because they have a damaged motor cortex and cerebellum. This brain damage can occur before, after or during birth. Causes of cerebral palsy before or during birth are Rh incompatibility, illness of the mother or severe lack of oxygen. Causes of CP after birth are head injury, lead poisoning or illness. These causes do not necessarily lead to cerebral palsy, but if they did symptoms can normally be seen during the first few years of life. The symptoms vary widely and can be physical or behavioral.

Since the symptoms vary greatly, the treatments do also. The treatments include orthopedic surgery, orthotics, botox injections, intrathecal baclofen, selective dorsal rhizotomy, speech therapy, occupational therapy and physical therapy. Orthopedic surgery corrects muscle and bone deformities caused by spasticity, but does not directly change the spasticity. Orthotics are casts or braces that reduce spasticity and stretch contracted muscles. They do so through two methods: (1) static bracing and (2) dynamic bracing. Botox injection is an extremely quick treatment that can reduce spasticity, but it is only used on a few muscle groups at a time and needs to be readministered every 3-4 months. Intrathecal baclofen involves implanting a pump into your child's lower abdomen. It can also reduce spasticity and its dosage can be changed throughout the day. Selective dorsal rhizotomy yields a permanent decrease in spasticity, but intensive physical therapy is needed afterwards for at least a year. Finally, physical therapy acts to stretch out a child's muscles and improves their ability to sit and walk. It does so through strengthening exercises and aiding motor development. The sequence of motor development is prone development, then supine development. This is followed by learning to sit, stand and walk. It has no side effects and can be used alone as a treatment. Physical therapy is very important in managing cerebral palsy. In fact, it is usually required as follow-up for the other treatments.



# Report on CEREBRAL PALSY AND ITS TREATMENTS

## I. INTRODUCTION

Wanting to be informed and to help others are parts of human nature. Therefore, when someone learns that their child or someone else they know has cerebral palsy, they are immediately interested and want to know what can be done to help. Cerebral palsy (CP) is a condition that is due to neurological damage and inhibits the child's normal developmental process. The United Cerebral Palsy Association states that 500-700,000 Americans have this condition [9]. Although there are many with cerebral palsy, it is most likely that no two people experience the same complications. Therefore, there are many different possible treatments. Physical therapy plays a large role in bettering the lives of these people either alone or in combination with other therapies. Together with a physician and a team of other health care professionals they can improve the child's day to day life.



The purpose of this report is to educate potential physical therapists and physical therapy assistants about cerebral palsy and its treatments. Since both can have a huge future impact on the lives of these patients, it is important that physical therapy and physical therapy assistant students know about the condition. It is also important that they know how they fit into the treatment plan and what their role is in bettering the lives of children with cerebral palsy. Potential physical therapists and physical therapy assistants need to be educated about the other cerebral treatments as well. This way they can later serve as information resources for their patients and can give their opinion as to which treatment program is best.

This report will be broken into three main sections with the first section containing background on cerebral palsy. This will include the types of CP, its causes, and its symptoms. The second section will be the current non-physical therapy treatments available for children with cerebral palsy. It will discuss orthopedic surgery, orthotics, two different drug therapies, selective dorsal rhizotomy, speech therapy, and occupational therapy. The drug therapies that will be discussed are botox injections and intrathecal baclofen. Finally, the third section will not only give background on the physical therapy treatment it will also include specific steps therapists use for motor developmental training in patients with cerebral palsy.



## II. CEREBRAL PALSY

*Mosby's Medical Dictionary* defines cerebral palsy as "a motor function disorder caused by a permanent, non-progressive defect or lesion present at birth or shortly thereafter [1:295]. "Cerebral" refers to brain and "palsy" refers to the lack of motor control. Therefore, cerebral palsy is used to describe a variety of conditions, which involve motor control and neurological defects. These conditions are grouped into four different main types of cerebral palsy.

### Types of Cerebral Palsy

The four types of cerebral palsy are spastic, athetoid, ataxic, and mixed forms [8] .

**Spastic.** Spastic cerebral palsy involves tense, contracted muscles. It is the most common form of cerebral palsy affecting about 70-80% of all people with the condition [3:7]. These people are said to have high muscle tone, which is when muscles are tight [3:4]. As a result, children with spasticity have stiff and awkward movements. They also have a hard time shifting positions and may grip tightly with hands such that it becomes hard to let go of things [8] . Spastic CP can be broken up into three subtypes: (1) diplegia, affecting one side, (2) hemiplegia, affecting both arms or both legs, and (3) quadriplegia affecting all limbs [8]. Spastic cerebral palsy results from damage to the part of the brain that controls voluntary movements, the motor cortex. When the motor cortex is damaged, it is hard for the brain to communicate with the muscles on either side of the body. Gersh states further that, "damage to the motor cortex on the left side of the brain makes it difficult to control movements on the right side of the body, and damage to the motor cortex on the right side makes it difficult to control movements on the left side of the body" [3:8].

**Athetoid.** Athetoid cerebral palsy is characterized by uncontrolled motion, especially in the face, arms and trunk. This can interfere with speaking, feeding, reaching, grabbing and any other skill, which requires coordinated movements [3:8]. These individuals have mixed muscle tone, meaning that sometimes the tone is too high and at other times it is too low. Athetosis is caused by damage to the cerebellum. The cerebellum is responsible for smooth, controlled movements and the ability to maintain posture. As a result of this damage, a child may develop purposeless, involuntary movements [3:8]. It is also possible that movements may increase due to stress and disappear during sleep [7].

**Ataxic.** The ataxic form is characterized by poor balance. This poor balance often results in stumbles and falls [10:6]. Like athetosis, ataxic cerebral palsy is also caused by damage to the part of the brain called the cerebellum. Again, this results in a lack of coordination and balance problems. Children with this form of cerebral palsy may also have tremors that worsen when they reach for objects. Ataxic CP only accounts for 10% of individuals with the condition.



**Mixed forms.** Mixed forms of cerebral palsy are also fairly common, occurring in 25% of people with cerebral palsy. These people have both spastic muscle tone and involuntary movements. They may also have low muscle tone in some muscles and high tone in others [8]. As is expected, they have damage to both the motor cortex and the cerebellum, which are the two areas of the brain damaged in the other types of cerebral palsy.

### **Causes of Cerebral Palsy**



Cerebral palsy can be caused by either developmental malformations or by neurological damage that occurs before, during or after birth.

**Developmental malformations.** Developmental malformation is the failure of the brain to develop correctly. In the first and second trimesters, a human embryo's brain cells divide and proliferate near the inner layers of the brain [3:11]. Then later they migrate to other areas of the brain depending on the function that they will serve. Sometimes a fetus' brain may fail to develop the normal number of brain cells, communication between them may be impaired, or the brain cells may not migrate to the area that they are supposed to. If these developmental malformations occur in the areas of the brain responsible for controlling voluntary movement, then cerebral palsy may result.

**Neurological damage.** Neurological damage can occur before, during or after birth [3:11]. There are three main causes of CP before and during birth [10:4]:



- *Rh incompatibility.* This refers to a blood conflict between the mother and the fetus. It occurs when the mother is missing the Rh factor (Rh-) and the fetus contains this Rh factor (Rh+), because the father was Rh+. Since the mother does not have the Rh factor, her immune system will set up an attack against the Rh factor of the baby. This may result in jaundice, which if severe can cause neurological damage or even be fatal [7].
- *Illnesses of the mother.* They include viral diseases, poor nutrition, diabetes, and alcohol or drugs.

- *Severe lack of oxygen.* There are several ways that the baby could be deprived of oxygen. First, the oxygen supply could be interrupted by premature separation of the placenta from the wall of the uterus. An awkward birth position, such as a breeched birth, could also be a cause as well as labor that is too long or abrupt. Finally, interference with circulation in the umbilical cord could deprive oxygen to the baby.

About 10-20% of people with cerebral palsy acquire the condition after birth. Accidental injury, lead poisoning or illness are main causes of cerebral palsy occurring after birth. Accidental injury can become a factor if the damage is to the head or through repeated shaking or beatings. Illnesses of the baby can lead to cerebral palsy just like illnesses to the mother. Examples are meningitis or encephalitis [10:4].

### **Symptoms of Cerebral Palsy**

The symptoms of cerebral palsy can vary greatly. Remember, "cerebral palsy" is used to describe "a variety of disorders that affect a child's ability to move and maintain posture" [3:2]. The symptoms of the different types of cerebral palsy were already discussed above. Most of the time symptoms are noticeable before the age of three. This section deals with symptoms of infants with cerebral palsy. These symptoms can be broken up into two main groups: physical symptoms and behavioral symptoms.

**Physical symptoms.** There are several physical symptoms that babies with cerebral palsy may have. These include, difficulty in sucking, poor muscle control, poor coordination, problems with seeing or hearing, muscle spasms and seizures. In general, these children have developmental delay in crawling, sitting, walking or any other milestone [7].

**Behavioral symptoms.** In addition to the physical symptoms, there are several behavioral symptoms which babies with cerebral palsy may exhibit. They include unusual tenseness, irritability, poor ability to concentrate, emotional problems and mental retardation in some.

### **III. NONPHYSICAL THERAPY TREATMENTS**

Just as there are many different symptoms of cerebral palsy, there are many different treatments. Remember though, these treatments only serve to help manage the condition and not to cure it. Cerebral palsy is non-curable. The treatments include orthopedic surgery, orthotics, drug therapies, selective dorsal rhizotomy, speech therapy and occupational therapy.

#### **Orthopedic Surgery**

According to the National Institute of Neurological Disorders and Strokes (NINDS), an orthopedist is "a surgeon who specializes in treating bones, muscles, tendons and other parts of the body's skeletal system [7]. Therefore, orthopedic surgery corrects the muscle and bone deformities caused by spasticity but can not directly change the spasticity itself. It can involve tendon lengthening, tendon transfer, or osteomy, which realigns the femur bone to correct alignment of the legs. Orthopedic surgery can lead to significant improvements in walking, improved range of motion and decreased deformity. On the other hand though, this will take time. In addition to taking time, there is a 25% chance of infection. It is also possible that the child will regress temporarily. In the meantime, it is essential that the patient get physical therapy on a regular basis. Orthopedic surgery can be done at any age usually starting from age four. It is best suited for children suffering from hip dislocations, tight muscles and bone or joint deformities. The cost is quite high, usually around \$20,000 or more.

#### **Orthotics**

Orthotics can be defined as "plastic, leather, or lightweight metal devices that provide stability to the joints or passively stretch the muscles" [3:75]. They serve to reduce spasticity, stretch tight muscles and to hold them in the stretch to prevent contracture. Contracture is when muscles become fixed in a tight, abnormal position. Orthotics can serve as treatment alone or in conjunction with other methods. The two main methods of orthotics are static bracing and dynamic bracing. Static bracing provides a much needed stretch for a long period of time. Then once this has been achieved the brace can be replaced with another one to increase the stretch further [2:85]. This method is referred to as serial casting and allows the muscles to stretch gradually over time with the goals being support, maintaining range of motion and providing as much mobility as possible. On the other hand, dynamic bracing is used to improve walking. These braces act to position the child's foot correctly and stabilize it. This is important since many people with spasticity tend to land on their toes or with their feet pointed in or out. As a result of these braces, tripping is reduced and walking may improve.

## Drug Therapies

There are two main drug therapies that are being administered currently. They are botox injections and intrathecal baclofen.

**Botox injections.** "Botox" is short for botulinum toxin. This toxin, as the name suggests, is toxic in large amounts. However, it is not toxic in this treatment since only a small amount is used based on the child's body weight. Botox injections are administered by a small needle injected directly into the spastic muscle and the whole treatment only takes a quick five minutes. Unlike the other drug therapies, botox injections are only used on a few muscle groups at a time. According to the article, "Spasticity Management for People with Cerebral Palsy", results of the treatment are usually not seen for 5-7 days but can last up to twelve weeks [5]. These results include improved walking and spasticity reduction for three months. It is even possible for the injections to provide permanent increased range of motion and its side effects are minor. The side effects are minor discomfort during treatment or possible rejection of subsequent injections by the body's immune system [5]. This treatment is used for children usually under the age of ten that have spastic diplegia or spastic quadriplegia. "Cerebral Palsy: Simple Notes on a Complex Problem" states that spastic diplegia affects the legs and is characterized by high muscle tone, which is when muscles appear tight [6]. On the other hand, spastic quadriplegia is high or spastic muscle tone affecting the arms, legs and trunk. The cost of the treatment is about \$365/ml but three to four milliliters may be used each time and usually the injections are given every 3-4 months [2:74]. Therefore, the cost can really add up, but that is the same for the other treatments as well.

**Intrathecal baclofen.** Intrathecal baclofen is for more diffuse spasticity. It involves the use of a pump, which looks kind of like a hockey puck. Figure 1 below shows the baclofen pump and where it is inserted.

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*Figure 1. The Baclofen Pump.* Baclofen is delivered into the spinal fluid by a pump implanted under the skin of the abdomen. Source: Albright, "Treatment of Spasticity: A Perspective". *Exceptional Parent*. September 1997, 81.

It is implanted into the lower abdomen so that the baclofen is delivered directly into the spinal cord. This procedure lasts about an hour and the

pump can be easily refilled every three months. According to "Spasticity Management for People with Cerebral Palsy," baclofen can decrease spasms and block abnormal nerve signals so that the patient can control his or her muscles [5]. This can make walking easier. The benefits of intrathecal baclofen over other drug therapies are that a smaller dosage is needed and that this dosage can be easily varied to fit spasm variations during the day. However, there are some possible risks. Of the patients undergoing this treatment, 5-10% may get an infection from the pump and 5-10% could have spinal fluid leaks. In these cases the pump would have to be removed immediately. The cost of this treatment is fairly high, ranging from \$20-25,000 [2:74]. However, it could greatly improve mobility.

### **Selective Dorsal Rhizotomy**

Another treatment used for diffuse spasticity is selective dorsal rhizotomy. This therapy is a neurosurgical treatment in which the nerves going to and from the leg muscles are exposed in the spinal canal [5]. Then 30-50% of the top half of each nerve is cut off. The advantage of this treatment is that it results in a permanent and irreversible decrease in spasticity. When combined with follow-up physical therapy, walking and the patient's active daily life can be greatly improved. Risks involve cutting excess nerve rootlets, which could create weakness and some loss of feeling to the legs. In addition, spasticity in the legs could redevelop as a result of growth spurts. The cost is over \$20,000 like baclofen [2:74], and four to six weeks of inpatient rehabilitation are needed to relearn basic motor and functional skills. Remember though, it may all be worth it since this treatment can result in a permanent decrease in spasticity.

### **Speech Therapy**

A symptom of many people with cerebral palsy is dysphagia, difficulty in speaking. As a result, speech therapy is needed to work on these specific difficulties to improve the speech of these patients. Speech therapists may also help children use special communication devices to aid their speech, such as a computer with a voice synthesizer [7].

### **Occupational Therapy**

Occupational therapists often work hand in hand with physical therapists. Their purpose is to help the patients develop skills like feeding, tooth brushing and dressing [7]. Occupational therapists improve the daily living of their patients at home, school and work. NINDS also claims to help reduce demands on caregivers and boost self-reliance and self-esteem [7].

## **IV. PHYSICAL THERAPY**

Although the other treatments vary greatly, they all have one thing in common. They all require physical therapy in conjunction with them in order to work on the muscles that have just been treated. For example, after selective dorsal rhizotomy physical therapists are needed since some motor skills need to be relearned. This section will go in depth describing what physical therapists and physical therapy assistants can do to help these patients. The ultimate goal of physical therapy is to help patients achieve independence. As for the age requirement, there is none. However, early intervention is important. Doctor Margaret Barry says that children's muscles and joints tend to get tighter and or painful as they get older if they are not treated [2:86]. If they are treated by a physical therapist, expected results are an increased range of motion, strength and function along with improved ease of care and minimized deformity. There are no risks, but the cost is \$100-150 per session [2: 74]. This is much cheaper than the drug therapies, but there are usually 2-3 sessions per week.

### **Goals**

As was mentioned above the ultimate goal is independence. However this can be broken down into three smaller goals [7]:

- To prevent muscle weakening (atrophy) following lack of use
- To avoid contracture which is defined by NINDS as "chronic shortening of a muscle due to abnormal tone and weakness associated with cerebral palsy. If contracture is not avoided in can cause loss of previous motor abilities.
- To improve the child's motor development

### **Techniques and Exercises**

Since there are so many different techniques and exercises done by physical therapists and physical therapy assistants, they can not possibly all be discussed here. Therefore, the ones used most commonly will be discussed. There are specific exercises to achieve each goal, but there is a lot of overlap. For example, impairing the child's motor development will also get the child to move his or her muscles and thus can prevent muscle atrophy as well. Therefore, a little will be mentioned about techniques to achieve each goal. Then the majority will focus on specific motor developments.

First, to prevent muscle atrophy do exercises that get the child moving. Play games with the child and do other fun exercises to make the child use her or his muscles. Using the muscles helps to strengthen them.

The next goal to work on is impairing the child's motor development. To do this, select techniques according to level and not according to age. Sophie Levitt states that this therapy has two main aspects: (1) specialized techniques for specific motor problems to initiate dormant motor activity, intensify correction and training of motor activity, and (2) techniques to integrate motor function with related areas of function in the child's activities of daily living [4:96]. Since the eyesight of these babies may be poor, the babies hands are slow to move and explore. Therefore, exercises need to be done to get their hands moving more. To do this, the therapist can have the baby practice putting his or her hands together or to stimulate their the body by rubbing it with towels or cream [4:101]. Also, give the child time to experience touch and sound whenever possible. All these are things mothers can do with their babies at home. A technique called "patterning" is based on the principle that motor skills should be taught in more or less the same sequence that they develop normally [7:28]. For example, the child is first taught to crawl before he is taught to walk. The specific steps of motor development, including prone development, supine development, sitting, standing and walking will be discussed in detail below.

Contracture can be avoided or eliminated by following the motor developmental sequences too. One other method that may be used is the Bobath technique. NINDS mentions that physical therapists using this technique position the child in opposing movements to what they are used to [7:27-28]. For example if a child normally keeps his arm flexed, physical therapists extend it manually or use a air splint to hold the arm in an extended position.

**Prone development.** This is the first development to work on with any child. Of course, special attention is needed for those with cerebral palsy. Prone is the position the body is in when it is lying flat on the front side. To get the child comfortable with this position, it may be necessary to place him or her slowly over your lap or over a large plastic ball. Figure 2 illustrates this.

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*Figure 2. Head Control and Development of the Prone Position.* To develop

this the child is rocked back and forth on the ball with arms extended. Source: Levitt, *Treatment of Cerebral Palsy and Motor Delay*. (Cambridge: University Press, 1995), 109.

Then bring the child's arms forward over the edge of the ball and rock the child back and forth with their face hanging over the edge [4:109]. Head control also needs to be worked on. This can be done by raising the head, holding it steady and turning it from side to side. Children with cerebral palsy may also tend to be weight bearing on a particular side [4:111]. To correct this, encourage the child to use the more affected side and gently push the child's weight on to it. Eventually the problem will be corrected. Next the physical therapist should encourage the child to rise on to their knees. Figure 3 shows a child on his knees while he is being entertained.

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*Figure 3. Child on His Hands and Knees.* The physical therapist should encourage this. Source: Levitt, *Treatment of Cerebral Palsy and Motor Delay*. (Cambridge: University Press, 1995), 117.

After several months of developing this, the therapist can get the child to put weight on their hands and feet to do the bear walk [4:128].

**Supine development.** The next exercises focus on supine development. Supine is the opposite of prone. It is the name of the position one is when lying on their back. To help the child develop this, therapists should start by having the child reach for things with their arms while in the supine position [4:130]. Then have the children do the same with their legs, except in this case have the child hold a hand up to grasp their foot. Levitt states that "raising reactions" are probably the most important activities to be trained in developing the supine position [4:131]. These exercises contribute to children learning how to get in and out of bed. Next, teach the children how to stabilize their head while in the supine position [4:131]. When this is finally achieved, the next development to acquire is the task of sitting.

**Sitting.** Proper sitting is a challenge to develop in a child with cerebral palsy. The following aspects are involved [4:148]:

- Vertical head control
- Control of the head and trunk

- Head or trunk rising. This involves teaching the child to come to an upright position from a hunched over position.
- Counterpoising. This involves having the child bend backwards so that they are no longer sitting upright. This is shown in Figure 4 below.
- Finally, tilt exercises will help improve the child's sit. These involve tilting the child forwards, backwards and sideways.

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*Figure 4. Counterpoising.* The child is bending backwards and then returning to an upright position to grab the ball. Source: Levitt, *Treatment of Cerebral Palsy and Motor Delay*. (Cambridge: University Press, 1995), 149.

For children with high tone or spastic cerebral palsy, development of the correct posture will take a lot of time and work on the parts of the therapist, child and parents. This is because spasticity causes the child to have abnormal sitting postures.

**Standing and walking.** The final stage is the development of standing and walking. This is by far the greatest challenge for patients with cerebral palsy. It is common for a child with cerebral palsy to never be able to walk or stand on their own. Support or the aid of a cane, walker or wheelchair may be necessary alternatives. However, some children may eventually be able to walk depending on their condition and the goals of the individual child and their physical therapist. To be able to walk though, these children must first be able to stand. Children with spastic cerebral palsy often have abnormal postures in standing due to their shortened muscles. According to Sophie Levitt, these children often use this spasticity to fix them in upright positions [4:183]. The following program is one she describes for training patients to walk:

1. Establish an equal distribution of weight on each foot
2. Correct abnormal posture
3. Increase stability
4. Delay training if necessary
5. Continue to develop head, trunk and pelvic fixation while sitting or standing
6. Practice weight shift leading to stepping
7. Train lateral stepping and walking holding support on each side. This can be done having the child side step around furniture while holding on to it Figure 5 is an illustration of a child doing that.

8. Train stopping, starting and turning
9. Train to use steps or inclines

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*Figure 5. Lateral Stepping.* This child is using furniture to practice side stepping. Source: Levitt, *Treatment of Cerebral Palsy and Motor Delay*. (Cambridge: University Press, 1995), 182.

If this is not possible, physical therapists can teach children to walk with walkers, canes or simply wheelchairs.

## V. CONCLUSION

Cerebral palsy is a condition characterized by many different symptoms ranging from tight muscles to uncontrolled motion and lack of balance. It affects many people and can not be cured, only managed. This report has discussed the types, causes and symptoms of CP. It has also provided the main treatments for managing the condition. They include orthopedic surgery, orthotics, botox injections, intrathecal baclofen, selective dorsal rhizotomy, speech therapy, occupational therapy, and physical therapy. For a review of these different treatments and how they compare to each other see figure 6 in appendix A. Remember that these treatments can be done alone or in conjunction with one another. However, all treatments work optimally if followed by physical therapy. That shows how important the physical therapist and physical therapy assistants are. They can allow the patient with cerebral palsy to learn to sit, stand or even walk. Overall, they allow the child to lead a more independent and better daily life. Every person with cerebral palsy is different, and it is the responsibility of a whole team of healthcare professionals to work together with the patient and their parents to help improve their day to day life. The physical therapist is just one of those healthcare professionals.

## APPENDIX A: TREATMENT SUMMARY TABLE

<b>Treatment Age</b>	<b>Age</b>	<b>For Whom?</b>	<b>Expected Results</b>	<b>Side Effects</b>	<b>Cost</b>
<i>Orthopedic Surgery</i>	Any age; usually over 4	Hip dislocations, muscle contractures, bone/joint deformities	Increased range of motion; improved gait; decreased deformity	Infection 25%; Bony non-unions	\$20,000+
<i>Botox Injections</i>	Any age; less often over 10	Spastic piplegia; spastic quadriplegia	Decreased spasticity; improved walking	Possible injection	\$365/ml
<i>Intrathecal Baclofen</i>	Over age 3	Spastic quadriplegia	Decrease in spasticity	Infection 5-10%; spinal fluid leaks	\$25,000+
<i>Selective Dorsal Rhizotomy</i>	Usually 4 to 8	Spastic diplegia; spastic quadriplegia	Permanent decrease in spasticity; improved walking	Small risk of infection or wounds	\$25,000+
<i>Occupational Therapy/ Physical Therapy</i>	Any age	Spasticity of any extremity	Increased range of motion, strength, function; improved gait	None	\$100-\$150 per session

Source: Rosenbaum, et al. "Treatment of Spasticity: A Perspective". *Exceptional Parent*. September 1997, 74.

## APPENDIX B: WORKS CITED PAGE

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