

# **A Clinical Observation of the Result of the Treatment for the Muscle Spasm in Childhood Cerebral Palsy (CP) with Botulinum Toxin Type A**

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## **Abstract**

**Objective:** To investigate the therapeutic effects of the botulinum toxin type A on the muscular spasmodic malformation in childhood cerebral palsy.

**Method:** The target muscular loci were injected with botulinum toxin type A in periodic doses to observe and evaluate the alternation of the muscular spasm before and after the treatment, the outcome in the correction of the malformation and the improvement of the motility function after the rehabilitating therapy.

**Result:** A remarkable remission for the muscular spasms was achieved after the therapy, providing reliable possibilities to rehabilitate the malformation, improve the motility capacity of the affected child and make the joint malformation corrected to different degrees.

**Conclusion:** The application of botulinum toxin type A in the treatment for childhood cerebral palsy is not only safe but effective as well. It may make the spasmodic muscles relaxed, the joint malformation corrected, and the motility function reconstituted.

**Key words:** Botulinum toxin type A; Childhood cerebral palsy; Muscular spasm; Target muscular locus (loci)

During April 1999 to December 2003, the Neurology Department of our hospital had totally 30 cases of inborn spasmodic palsy patients from the in-patient, Rehabilitation Center of Cerebral Palsy, West China Center of Medical Sciences and Cerebral Palsy Rehabilitation Center of Sichuan Chinese Medicine Institute. According to the diagnosis standard of Practical Neurology 2<sup>nd</sup> edition, 30 cases of affected children used botulinum toxin type A for treatment of muscular spasmodic malformation before rehabilitation therapy. The therapy provided a valuable condition for the rehabilitation of malformation, improved the motility function and provided different degrees of curative effect, which are concluded as follows:

## **Information and Method**

### **1. General Information**

Among the 30 cases, there were 22 males and 8 females aged from 16 months to 9

years old. 9 cases were premature birth, 2 cases were postmature delivery, 8 cases were under-weight, 7 cases were dystocia, 4 cases were with drug taken by mother during pregnancy; 5 cases were apnea after delivery, 2 cases were jaundice. There were 7/30 children with intelligence quotient (IQ) below 70 marks. There were 19/30 whose podosoma ability quotient was affected to be low. 17 cases showed different degrees of abnormal cerebral cortex development under MRI inspection, among those 5 cases were combined lobar sclerosis. 18 out of 28 cases of CT inspection showed abnormal cerebrum development. 7 cases showed neurogenic damage under electromyography inspection. 5 cases showed normal cerebrospinal fluid under inspection.

24 cases during the rehabilitation treatment, 6 cases before the rehabilitation treatment, were injected with botulinum toxin type A at selected target muscular locus by specific person, once a week, total 3 – 4 times. For the serious cases, the first-time-injection dosage was doubled. Three days after the first injection, all of the affected children started the rehabilitation treatment. They were visited at 2 months, 3 months, six months, 1 year and 2 years after the treatment, tracing photos were taken from 6 cases.

All the 30 cases processed different degrees of dropping foot. There were 17 cases of cross-leg and scissors-like gait, 6 cases were knee joint rigidity, 3 cases were introversion taut foot, 4 cases were extroversion taut foot, 5 cases were elbow extension and carpus pronation, 4 cases were carpus flexion and finger flexion. Among all cases, 13 cases showed different degrees of muscular atrophy of the palsy podosoma. Before treatment, 28 cases had taken discontinuously the cerebral cell nutritional agents, cerebrolysin, ganglioside, GM-1, methycobal and vitamin B group, at the same time combined with acupuncture and moxibustion, rehabilitation treatment and physiotherapy. Intelligence Quotient (IQ) of 4 cases was increased, motility function of 5 cases was improved, but no obvious changes in muscular spasmodic malformation.

## **2. Method**

### **2.1 Medicine Treatment**

Medicine: Freeze-dried crystalline Botulinum toxin A manufactured by Lanzhou Institute of Biological Products, 100U per vial, stored at fridge, constituted with sterile normal saline to 2.5U per 0.1 ml. Targeted muscular locus injections with different dosages were applied to different cases, according to the state of illness. The general dosage was 110U each time, first-time dosage of 5 serious cases were doubled

to 220U, and the injection frequency was once a week, totally 2 – 4 times treatment for each case. Each target muscular locus was injected with 2.5U. For the most serious cases, the malformation did not completely improve and needed to be injected 1 -2 more times in 3 – 6 months. **2.** Selection of targeted muscular locus injection: the long adductor muscle, short adductor muscle and great adductor muscle at the crural inner side were selected for the treatment of cross-leg, scissors gait; the inner musculus flexor, front outer muscle group and etc, the muscle group behind the leg were selected for drop foot, intro- and extroversion of taut foot; the quadriceps muscle of thigh, and musculus sartorius were selected for knee joint rigidity treatment. Brachial triceps muscle, pronator teres, pronator quadratus, extensor of front arm and etc. were selected for the treatment of elbow extension, carpus pronation, carpus flexion and arm flexion. According to the size, amount and anatomic section of target muscle, agonistic muscle or antagonistic muscle, the surface-projected locus injection points were selected. A little amount of deep target muscles could be fixed by electromyography. To prevent dispersion of injection affecting the effectiveness, gentian violet pointing and iodine fixing were applied to each locus. Each points were distant by 2 cm, during the injection, one should try hard to be accurate, the injection should be with suitable depth, and directly reach the belly of muscle. Among those 30 cases, 5 cases were injected twice, 18 cases processed three injections, and 7 cases processed four injections. For the 4 serious cases, supplementary injections were processed 3 and 6 months after treatment, the dosage was 110U for each. The selection of target muscular locus injection was shown in Table 1, the dosage and the number of locus for every injection were shown in Table 2.

**Table 1 Selected Muscle (Group) for the treatment of Childhood CP Muscular Spasm**

Type	No. of case(s)	Selected muscle (group)
<b>Cross-leg and scissors gait</b>	17	Long adductor muscle, Short adductor muscle and Great adductor muscle
<b>Drop foot</b>	24	Gastrocnemius muscle, Musculus soleus and Posterior tibial muscle
<b>Introversion taut foot</b>	3	Long flexor muscle of toe
<b>Extroversion taut foot</b>	5	Musculus peroneus longus, Musculus peroneus brevis and Musculus extensor digitorum longus pedis
<b>Knee joint rigidity</b>	6	Quadriceps muscle of thigh and Muscles sartorius
<b>Elbow extension and Carpus pronation</b>	5	Brachial triceps muscle, Pronator teres and Pronator quadratus
<b>Carpus flexion and Finger flexion</b>	4	Radial flexor muscle of wrist, Ulnar flexor muscle of wrist and Finger
<b>Musculus flexor superficialis, Deep flexor muscle of fingers, Long flexor muscle of great toe, Short flexor muscle of great toe and Musculus flexor digiti quinti brevis</b>		

## **2.2 Rehabilitation Training and Physiotherapy**

For the 30 cases, rehabilitation treatment and physiotherapy started after 3 days of injection. Each case was evaluated by rehabilitation healer according to Dr. Koman grading method before treatment <sup>[1]</sup>. According to the characteristics of each case, special-designed rehabilitation plans were designed in order to carry out accommodative rehabilitation treatments. At the same time, the parents were guided to train their affected children for walk and motion training. The exercisers, walking frames, waist belt, pedal cycle etc, were used for the training of those unable to walk or walked with unbalance gait, until they could walk independently. For each time of rehabilitation treatment, healer should strengthen the training of hip flexion, hip abduction, ankle flexion, elbow flexion, shoulder extension and holding object for affected child. After relaxation of spasmodic muscle, training of lumbar muscle was the most important point for walking. Once the standing reflection was built, the walking ability should be convalesced very soon. 5 cases of this group used special orthopedic shoes during training for the correction of intro- and extroversion foot

malformation. For the physiotherapy, mainly used of short wave, ultra-short wave, frequency spectrometer heat treatment, combined with acupuncture and moxibustion and massage improving the blood cycle, it convalesced the motion function.

### 2.3 Evaluation of Effectiveness

30 cases were evaluated according the Dr. Koman grading method (Physician rating Scale, PRS) before treatment. The evaluation standard was accorded by the degrees of hip, knee, ankle, elbow and carpus joints malformation correction, combined with the characteristics of cases, evaluated as the following Table 3. See Table 4 for the evaluation of 30 cases before treatment

**Table 2 Injection Dosage and Numbers of Locus of Each Muscle (Group)**

<b>Name of Muscle (Group)</b>	<b>Injection Dosage (U)</b>	<b>No. of locus</b>
Long adductor muscle	15 – 30	6
Short adductor muscle	10 – 20	4
Great adductor muscle	10 – 20	4
Gastrocnemius muscle	30 – 50	16
Musculus soleus	20 - 30	8
Posterior tibial muscle	15 – 20	6
Long flexor muscle of toe	20 – 30	8
Musculus peroneus longus	20 – 30	8
Musculus peroneus brevis	10 – 20	4
Musculus extensor digitorum longus pedis	10 – 20	4
Brachial triceps muscle	20 – 30	10
Pronator teres	10 – 20	6
Pronator quadratus	10 – 20	4
Radial flexor muscle of wrist	10 – 20	4
Ulnar flexor muscle of wrist	10 – 20	4
Brachioradial muscle	10 – 20	4
Superficial flexor muscle of fingers	10 – 20	4
Deep flexor muscle of fingers	10 – 20	4
Long flexor muscle of great toe	5 – 10	3
Short flexor muscle of great toe	5 – 10	3
Musculus flexor digiti quinti brevis	5 – 10	3
Quadriceps muscle of thigh	30 – 50	16
Muscles sartorius	10 – 20	6

**Table 3 Dr. Koman Marking Skim**

<b>Elbow extension, Carpus Pronation, arm flexion</b>	<b>Mark</b>	<b>Drop foot</b>	<b>Mark</b>	<b>Strand angle of cross-leg</b>	<b>Mark</b>	<b>Knee joint rigidity</b>	<b>Mark</b>
<b>Malformation unchanged</b>	0	Malformation unchanged	0	<30°	0	Flexion <30°	0
<b>Malformation passively corrected</b>	1	Malformation passively improved	1	<40°	1	Flexion >45°	1
<b>Malformation suddenly corrected</b>	2	Heel suddenly ground	2	<60°	2	Flexion >60°	2
<b>Freely moved</b>	3	Heel ground normally	3	>60°	3	Flexion >90°	3



## **Result**

The treatment of this 30 cases group were shown effective, the effectiveness reached 96.7%. After Statistic calculation, there was an obvious difference before and after treatment. ( $t = 3.88$   $P = 0.01$ ) similar to the foreigner reports <sup>[2]</sup>. 30 cases of dropping foot combined with 3 cases of introversion haut foot and 4 cases of extroversion haut foot, 17 cases of them were completely corrected and 13 cases were partially corrected. 13 cases were unable to walk before treatment. After treatment, 7 cases of them able to walk steadily, 2 cases of them were able to walk for a short distance, and 4 cases were able to walk under parental guidance. 17 cases of cross-leg and scissors's gait were completely corrected, 13 cases were able to achieve the normal strand angle, 4 cases were partially corrected, and the strand angles were larger after treatment. 4 of the 6 cases with knee joint rigidity were completely corrected, and 2 of the 6 cases were partially corrected. 3 of the 9 cases with elbow extension and carpus pronation, and finger flexion were completely corrected, 5 cases were partially corrected, and 1 case was not affected.

After 3 days of the botulinum toxin type A injection treatment of those 30 cases, 22 cases showed relaxation and elongation of the spasmodic muscle. Therefore, we applied rehabilitation treatment 3 days after injection. Most of the affected children had improvement in their malformation after 1 – 2 weeks; 3 weeks after the injection, the improvement showed obviously, and the malformation of most affected children were corrected 4 weeks after treatment. According to the clinical observation, the malformation correction of lower extremity was faster than upper extremity, and the ratio of complete correction was also greater than that of upper extremity.

Among those 30 cases, 16 cases were visited for 2 months to 2 years, 9 cases were registered to day nursery or school.

In those 30 affected children cases, 6 cases showed slightly weakness of lower extremity, 3 cases' finger showed weakness of uplift. After stopped treatment for 1 month, the symptom of weakness disappeared. After treatment of the 30 cases, the blood status, urination frequency, and liver function were normal. No special adverse response and side effect was processed.

## **Discussion**

Childhood Cerebral Palsy is an integrative description which includes many kinds of cerebral lesion-induced inborn muscular tension and functional changes, motility limitation, cerebral function disable, and below-normal intelligence quotient etc.



Although it was defined as inborn disease, there are also some acquired factors. The objective of childhood CP treatment was: recovery of motility function, and reduction of the disable chance. In the clinical practice, the way to enhance the cure ratio, and the improvement of treatment method, were being the research topic of the neurology and rehabilitating therapist. Although rehabilitation treatment could improve the motility function of most CP Children, muscular spasm always hindrances the treatment process. This will increase the work load of rehabilitation healer and delay the rehabilitation time. There were even cases from individual hospital that during the cross-leg treatment by rehabilitation healer, due to the large resistant force from hip expansion, the over-applied force induced fracture to CP Children. After simple rehabilitation treatment, the problem of muscular spasm was not solved, once stopped the treatment, the motion inhabitation due to malformation occurred again, the treatment provided by rehabilitation healer become useless, this kind of case was usually observed.

LANTOX has been used in the clinical treatment of focal dystonia disease, it is accurate and reliable especially in the treatment of local muscular spasm, and has been well known by clinical workers <sup>[3]</sup>. Botulinum toxin type A acted on the surrounding of motion never ending junctions, inhibited the release of acetylcholine from presynaptic membrane, induced muscular relaxing paralysis <sup>[4]</sup>. Foreign electrophysiology researcher proved that botulinum toxin type A acted a dual action of afferent fibers and efferent motoneurons <sup>[5]</sup>. This (pharmacology) acted on special condition, relaxed and elongated the spasmodic muscle, reconstituted the flexed joint into normal, heel moved downward to ground, and relaxed and reinstated of rigidity joint <sup>[2]</sup>.

3 – 7 days after injection of botulinum toxin type A to this 30 cases group of CP children, the spasmodic muscle of them showed different levels of relaxation and elongation. 3 cases' heels basically able to step on tough ground and walk steadily after 7 days of injection. Rehabilitation healer popularly reported that after 3 – 7 days of injection, the resistant force was reduced during treatment; the joint malformation of some of CP children were reinstated temporary, the malformation correcting action could be achieved easily. It proved the accuracy and effectiveness of the botulinum toxin type A in the treatment.

We thought that in the treatment of CP child muscular spasmodic malformation, the specificity of each individual case should be noted and specific rehabilitation should be provided. For example, in the treatment of cross-leg and scissors's gait, treatment was specified on hip flexion, hip expansion and hip abduction; when the injection

frequency was increased and the dosage were accumulated, The rehabilitation treatment time should be extended, the hip abduction to the thigh angle return to normal position, conducting more gait training, corrected the scissors gait. Through the rehabilitation treatment, consolidating of the action time of LANTOX, achieved the clinical effect of permanent cure of some CP children<sup>[2]</sup>.

The reason of bad correction result of carpus and hand malformation in this CP children group was related to the small size of the motion control muscle, and overlapping of the anatomic position. The smaller size and deeper position of the muscle, the more difficulties to handle the injection dosage and depth, the effect, would of course worse than that of massive muscle. Although applying electromyography enables to improve the accuracy, it's not suitable for CP child, and difficult to apply into clinical level. It's still looking for improvement to enhance the effectiveness.

Using LANTOX in the treatment of children CP muscular spasmodic malformation is a safety, effective and brand-new method. It could enhance the clinical effectiveness, reduced the crippling rate of affected children. Especially before the rehabilitation treatment, use of LANTOX enabled to relax and elongate the spasmodic muscle, provide the most valuable and the best chance for rehabilitation healer for treatment, it helped the rehabilitation of CP children. For this, we suggest promoting the application of it in rehabilitation department of every hospital; more CP children were able to return into society and school, earn a living by their own hands, to decrease relief the social and family economic.

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