

Treatment of Masticatory Spasticity by Children with a Cerebral Spastic Infantile Paralysis from a Comparative Perspective

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Abstract

A cerebral spastic infantile paralysis is a persistent lesion of the nervous system, with stable, progressive consequences. A muscle hypertonicity is one of the leading complication, that can progress. Children are not able to do oral hygiene correctly, because of spasticity of chewing muscles and that leads to limitation of oral cavity opening. As a result, a huge amount of dental diseases are developing. Dental care for such patients must be provided with a specific approach. An elimination of hypertonicity have to be a primary place of influence. Now a days, there are a lot of ways to treat this disease. The aim is to compare the effectiveness of masticatory muscle hypertonicity treatment in children with cerebral spastic infantile paralysis.

Patients were divided into two groups: in the first group kinesio taping was used to reduce spasticity; in the second group was assigned a complex of adaptive myogymnastics with a pneumatic simulator mouth expander. Clinical results were estimated by developed screening diagnostics and functional results after an electromyographic study after 14 days and after 3 months.

Positive results of treatment were obtained in both groups. Children had a reliable improvement of clinical and electromyographic ranges. However, kinesio taping had faster result in a short time, at the same time, statistical significances were not identified Conducting adaptive myogymnastics in combination with the simulator mouth expander is potentially more effective, as shown reliably by statistical analysis of the data.

The research has proven that for the elimination of hypertonicity doctors need to use the kinesio taping and the complex of adaptive myogymnastics. Side effects and complications were not detected. The treatment plan have to be individual for each patients considering clinical situation.

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Introduction

Children, who have a cerebral palsy need a special approach to dental treatment. It might be justified by the fact that, on the one hand they

are unable to perform oral hygiene on their own, on the other hand by the fact that they are unable to open their mouth fully due to hypertonicity of the masticatory muscles.¹Dental care for these patients is often only available in surgery where teeth are extracted under general anaesthesia¹. However, children with cerebral spastic infantile paralysis need special care and attention during dental treatment. The dental status of this pathology is very different from that of healthy age mates, characterized by the highest prevalence of caries and its complications, pathological erosion, periodontal

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disease due to an abundance of plaque.² Preventive care is important, since the consequences of dental disease are life-threatening and may lead to complications from common comorbidities².

Children with cerebral spastic infantile paralysis require careful treatment planning and the approach to dental care may vary during the management phase.³ The first step is to address the cause that aggravates and triggers the development of oral disease, i.e. to treat muscle hypertonicity of the masticatory muscles so that children can open their mouths fully and brush their teeth³.

A hypertonicity of chewing muscles is diagnosed based on a thorough history and clinical examination.⁴ The doctor needs to use unified inspection scheme⁴. First of all, dentist need to explain to the patient the purpose of each step. The diagnostic scheme of hypertonicity chewing muscles is presented below (fig. 1):

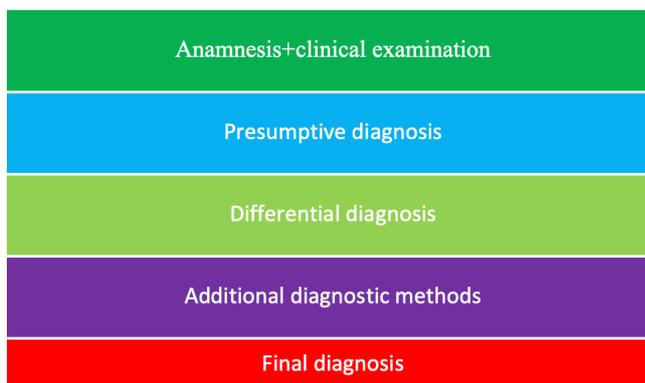


Figure 1. The scheme of dental treatment for children with a cerebral spastic infantile paralysis.

Dental checkup is carried out with a help of the main and additional methods of treatment.⁵ Main methods are: general inspection, that allows to find the symptoms of disease, an estimate of speech production and an analysis of the expression of emotions⁵. At the second stage, the analysis of the work of chewing muscles, a chewing ability and a pain intensity of masticatory muscles is carried out (duration, palpation pain) Palpation may reveal muscle thickening, symptoms of allodynia or hyperalgesia, and involuntary contractions of individual muscle bundles or muscles in general. Palpation of the lymph nodes is performed to rule out inflammation. For additional methods of investigation, it is advisable to perform

electromyography, which measures the electrical activity of muscles at rest, during voluntary contractions and during special tests. This can clarify the presence of muscle overactivity and detect impaired neuromuscular transmission.

The next step in the management of children with cerebral spastic infantile paralysis is to develop a treatment plan.⁶ The focus in this category of patients should be on preventive measures, as the disease can significantly worsen the condition of the frail child⁶.

The management of children with cerebral spastic infantile paralysis should be undertaken in a holistic manner, in conjunction with allied health professionals (fig. 2).

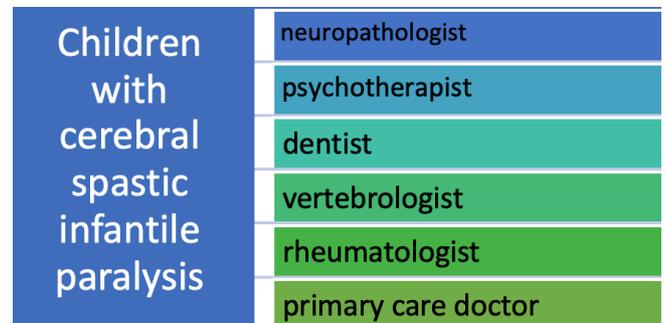


Figure 2. Interdisciplinary approach to tactics of treatment of children with cerebral spastic infantile paralysis.

First of all, we need to influence on chewing muscles, to prevent muscle hypertonicity⁷. There are now many ways to treat muscle spasticity: injections of botulinum neuroprotein, kinesiotaping, adaptive myogymnastics.

Injections of botulotoxin significantly stop hypertonus of masticatory muscles, having short and longterms effect.⁸ However the medication is rather expensive and not everyone can afford it⁸. Kinesiotaping came from sport medicine, it is used for rehabilitation of patients, with diseases of the musculoskeletal system. There are two aspects of taping: mechanic and receptor. The tape is pasted on skin and it influences on muscle, vascular, connective and nerve tissues.⁹ Placing the tape on spastic masticatory muscle without tension is needed to accelerate blood circulation and recovery of the muscle tonus⁹.

During the complex of adaptive misogynistic was created a mouth extender, which provides sparing regulated influence on

spasticity and on separation of dental arch, for facilitating dental treatment in oral cavity¹⁰.

Stopping of hypertonicity of masticatory muscle allows to recover and normalise functions of chewing, speech formation, swallowing, to enhance the quality of dental care for children with cerebral spastic infantile paralysis¹¹.

However the main task of a dentist is to choose adequate methods and remedy for diagnostic and treatment of spasticity¹². A comparative analysis of the effectiveness of masticatory muscle hypertonicity treatment in children with cerebral spastic infantile paralysis is the aim of this study.

Goal of the research – to hold the comparative analysis of effectiveness methods of stopping hypertonus chewing muscles for children with cerebral spastic infantile paralysis during dental visit.

Materials and methods

There was conducted an examination and treatment of 56 children with ICP for the purpose achievement. The form was spastic diplegia (G.80.1), spastic C.P. (G.80.0) 6-12 years old (that age considers the rate of motility and limitations is everyday life of patients with ICP. ¹³Average age was $8,7 \pm 0,3$ years old accordance with clinical guidelines¹³. The research was approved by local ethics committee of Volgograd state medical university (protocol №14 from 19.11.21).

We were guided by authors of screening diagnostics of hypertonus chewing muscle of children with cerebral spastic infantile paralysis during the clinical examination¹⁴. The research was accessed chewing ability, speech, swallowing emotion expression, intensity and duration of pain, disfunction of lower jaw. Palpation of chewing muscle was accessed with painfulness: scale from 0 to 3 (visual analog scale): 0 points now tension and painfulness; 1 point-slight tension of muscle, no painfulness while palpation; 2 points moderate tension and painful while palpation (feeling of discomfort); 3 points - strong tension and sharp painfulness, painful lumps. Electromyography (EMG) research was performed by 4-channel device "Sinapsis". During functional testing parafunction of chewing muscles are evaluated electromyography results: right temporal muscle, right chewing muscle, left temporal, left chewing and total biopotential of

temporal and chewing muscles (fig. 3).



Figure 3. Conducting EMG research. Author's photo.



Figure 4. Conducting kinesiotaping to children with ICP, author's photo.

For receiving normalised values of EMG results we compared the results to a group of healthy child (29 people) at the same age group.

Children with ICP were divided into two groups according to the methods of stopping spasticity of chewing muscle randomly: 1st group (28 people) - stopping hypertonus was made by kinesiotaping. Primarily the face skin in area of chewing muscle was treated, proper size tape was placed as "anchor" type without tension or

with slight tension according to clinical situation (from 5-25% tension). Tape was placed for 48 hours(fig. 4).

While removing the tape we need to hold the skin to avoid hair tension and to prevent discomfort and pain. For children the procedure of removing was not painful , so we need to smear the tape with fat cream , wait for 5-7 minutes while the cream reacting with tape and worsening adhesion properties. Kinesiotaping was held by a scheme: during 3 month: 2 weeks tape placing, 2 weeks break.

For patients of the 2nd group (28 people) adaptive complex of myogymnastic with mouth expander. (fig. 5).

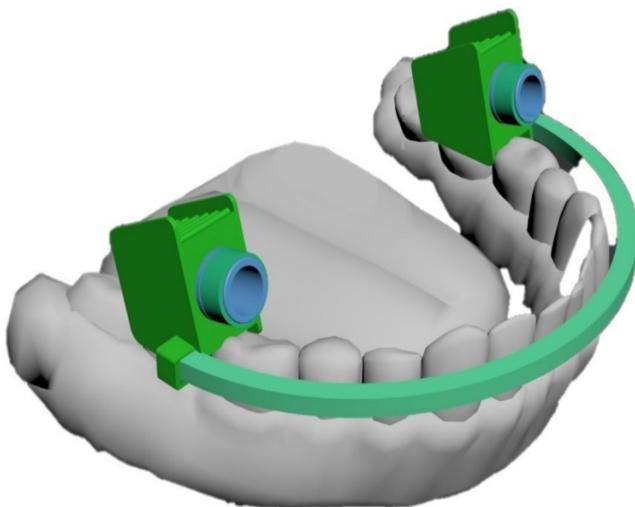


Figure 5. Scheme of pneumomachine – mouthexpander.

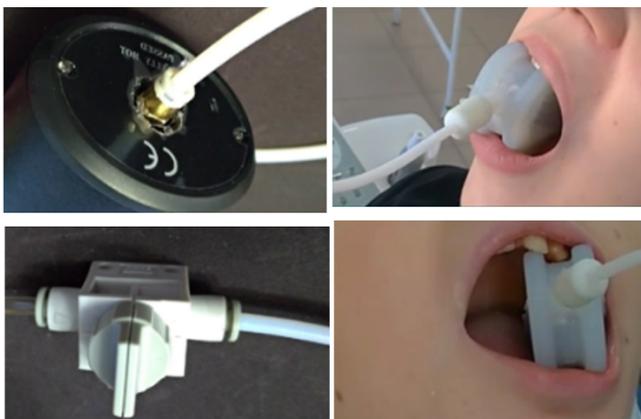


Figure 6. Algorithm of pneumomachine – mouthexpander.

Instruction of using of pneumomachine - mouthexpander.

1. plug the device to compressor

2. install the selicon block in oral cavity , dental arch should be placed in tooth slots

3. Switch on the compressor (max. pressure 1.8-2.0bar.)

4. Reaching the values you should shut off the value.

5. All the further manipulation's should be conduct according to doctors prescriptions. (fig.6).

Hold the pressure with device during 10 sec., open the valve, relieve pressure, let the patient have a rest for 10 sec. and repeat the cycle (p.2-4). Hold 10 cycles . Repeat the procedure two times a day. Carry out the complex of adaptive miogymnastic daily during 2 weeks , 10 cycles, 2 times a day in the morning and evening ; during 3 months with two weeks break between courses.

The results are processed before therapy , after two weeks and after 6 month by variational statistic method on PC, Excel programme , operating system Windows XP(Microsoft corp.USA) according to common methods of medical statistics , and with usage of apps Stat Soft Statist v6.0. Statistic analyse was held by method of variational statistic defining average value (M) , an average error (1m), mark of difference between groups according to student criteria (t) . The difference between compared indicators (index) was considered as reliable it $p < 0,05$ $t \geq 2$.

Results

The following results were received by clinical exam before concluding the therapy. The analyze of chewing ability was $3,9 \pm 0,1$ points, that shows process of hardly food chewing, analysis of speech $-4,0 \pm 0,1$ point (the child speaks with difficulty), the evaluation of swallowing – $3,9 \pm 0,1$ (expression of emotions is with difficulty, the child can hardly laugh), the intensity of pain was $7,0 \pm 0,04$ points (tolerable pain), and disability of lower jaw was due to pain – $4,1 \pm 0,14$ points. As for duration of pain indicators show $3,8 \pm 0,13$ points. The EMG results of children with ICP by concluding functional probes for parafunction of chewing muscles were right: temporal muscle - $1032,56 \pm 143,9$ uV, right chewing muscle - $1524,57 \pm 112,86$ uV, left temporal – $1077,34 \pm 123,7$ uV, left chewing muscle –

1099±119,39 uV. Total biopotential of temporal muscles research 5854±342,43 uV , chewing – 5476,83±296,3 uV.

The EMG results of healthy children by concluding functional probe for parafunction of chewing muscles were: right temporal – 259,5±25,23 uV, right chewing – 319,3±1,74 uV, left temporal -271,68±28,4 uV, left chewing - 301,31±35,24 uV. Total biopotential of temporal muscles was 1974±127,53 uV, chewing – 2087±113,37.

The comparative analysis of the EMG results showed statistic significant of received data $p < 0,05$. The children with ICP got significant higher indicators, more than 2 times, in compare with control group, that confirmed the muscle hypertonus diagnosis. The results of clinical exam below according comparing groups after 14 days are in the table 1.

	Chewing capacity analysis	Analysis of the speech	Swallowing assessment	Analysis of emotional expression	Pain intensity	Assessment of lower jaw dysfunction
I group	2,1±0,1	2,0±0,1	2,3±0,1	2,7±0,2	3,0±0,2	3,0±0,1
II group	2,5±0,1	2,3±0,2	2,6±0,1	2,4±0,1	4,8±0,4	3,1±0,2

Table 1. Results of screening diagnostics of masticatory muscle hypertonicity, points.

*statistical significance of differences at $p < 0,05$.

As can we see from obtained results, masticatory ability, speech formation , swallowing, expression of emotions are better of patients that use the method of kinesiotherapy for stopping hypertonicity, though statistic significance wasn't revealed (for $p > 0,05$). Also the patients from 1st group note less painfulness of masticatory muscles, but the indicator of intensity of painfulness was 33,3% lower than comparing group ($< 0,05$).

The EMG results were corresponded to clinical exam data. Statistic significance was not revealed between groups ($p > 0,05$). The EMG results of functional probes (test) for parafunction of masticatory muscles, the patients of 1st group: right temporal -774,6±126,6uV, right masticatory – 1175,56±97,55 uV, left temporal – 725,48±111,83 uV, left masticatory 913±83,34 uV. Total biopotential of temporal muscle - 4365±252,65 uV; masticatory – 4525,63±183,46uV.

The EMG results of functional probes (test) for parafunction of masticatory muscles, the patients of 2nd group: right temporal - 759,84±97.43mkV, right masticatory –

958±93,96mkV, left temporal – 711,94±87,45 mkV, left masticatory 893,64±106,24 mkV. Total biopotential of temporal muscle - 4585,64±187,73 mkV; masticatory – 4791,58±167,14mkV.

After 6 months from the start of therapy, the following values were obtained during the screening examination and diagnostics (tab. 2).

	Chewing capacity analysis	Analysis of the speech	Swallowing assessment	Analysis of emotional expression	Pain intensity	Assessment of lower jaw dysfunction
Before therapy	3,9±0,1*	4,0±0,1*	3,9±0,1*	3,5±0,1*	7,0±0,04*	4,1±0,14*
I group	2,5±0,2**	2,7±0,1**	2,5±0,1**	2,6±0,1**	5,0±0,2**	3,2±0,09**
II group	1,9±0,1***	1,8±0,1***	2,2±0,1***	1,9±0,1***	4,9±0,04***	2,7±0,12***

Table 2. Results of clinical examination after 6 months.

* statistical significance of differences relative to the pre-treatment figure, at $p < 0.05$.

** statistical significance of differences between comparison groups, at $p < 0.01$.

Both groups showed improvement in clinical parameters, as evidenced by the statistical significance of the differences, at $p < 0.05$. However, relief of masticatory muscular hypertonicity occurred more intensively in patients against the background of adaptive myogymnastics in combination with a pneumomachine - mouthexpander.

During functional tests in group 1 patients for masticatory muscle parafunction, EMG results were: temporalis muscle on the right 973 ± 94.2 uV, masseter muscle on the right 976.54 ± 78.35 uV, left temporalis muscle 938.94 ± 84.26 uV, left masseter muscle 931±75.36 uV. The total biopotential on the temporal muscles was 5824±167.56 uV, on the masseter muscles 5024.94±145.74 uV.

Patients in the second group had the following electromyographic findings - right temporalis muscle 636.84±47.43 uV, right masseter muscle 858.0±93.96 uV, left temporalis muscle 705.42±67.45 uV, left masseter muscle 853.64±96.24 uV. Total biopotential on temporal muscles was 4110.2±87.73 uV, on masseter muscles 4653.58±67.14 uV.

The results of the electromyographic examination are consistent with those of the screening examination, with the total biopotentials of the temporal and masseter muscles being 1.4 and 1.1 times lower respectively in group 2 patients than in group 1.

Discussion

The management of hypertonicity in children with spastic cerebral palsy is an important aspect in the treatment and prevention of dental disease¹⁵. To date, there is a wide variety of isokinetic exercise techniques, however, they have a short-term effect. It is necessary and appropriate to include in the treatment regimen active myotraining devices with the possibility of active influence on the masticatory muscles.

The inclusion of an adaptive myogymnastics complex with the developed pneumatic rotary exerciser for myogymnastic purposes is an effective method of relieving hypertonicity¹⁶. Orthopaedic, orthodontic, physiotherapeutic treatment, as well as the use of mouth guards are relatively effective, but there is no exact understanding of their mechanism of action. Some patients experience a temporary improvement, while others develop a chronic, lingering condition that is not amenable to any known modern treatment methods¹⁷. Thus, finding and developing ways of non-invasive comprehensive treatment of masticatory muscle hypertonicity as a root cause of oral diseases in children with ICP remains an important and urgent issue.

Conclusions

The study proved that in order to relieve muscular hypertonicity it is advisable to include kinesiotaping and a complex of adaptive myogymnastics in the treatment regimen. Positive results were obtained in both groups. It should be noted that tapes have a faster but short-term effect compared to rehabilitation exercises. However, myogymnastics in combination with a rotator pneumatic trainer is in the long run a more effective technique for reducing spasticity of the masticatory muscles.

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Declaration of Interest

The authors report no conflicts of interest

pertaining to any of the products or companies discussed in this article.

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