



Tongue mobility in patients with cerebral palsy

Pokretljivost jezika kod bolesnika sa cerebralnom paralizom

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Abstract

Background/Aim. In children with cerebral palsy speech is a big problem. Speech of these children is more or less understandable, depending on the degree of reduced mobility of articulatory organs. Reduced mobility is affected by inability to control facial grimacing and poor muscle strength when performing targeted movements. The aim of this study was to determine the mobility of tongue in patients with cerebral palsy. **Methods.** The study included a sample of 34 children – patients with cerebral palsy who had been treated in the Special Hospital for the Cerebral Palsy and Developmental Neurology in Belgrade. The patients were divided according to the determined diagnosis into two groups: *Quadriparesis spastica* (n = 11) and *Morbus Little* (n = 16). The children, aged 8–12 years, had preserved intellectual abilities, and all of them had preserved hearing. The study was conducted during the period from January to September 2009. The functional state of articulatory organs in both groups was tested by the C-test that examines the anatomic structure and mobility of the articulatory organs. **Results.** Our research showed that both groups of the patients had impaired functional state of the tongue – the most mobile articulatory organ. Also, the research showed that the functional state of the tongue was worse in children diagnosed with *Quadriparesis spastica*. A statistically significant correlation between the diagnosis and the functional state of the tongue, the tongue test performance and the retention of the tongue in a given position was found ($r = 0.594$, $p < 0.005$; $r = 0.816$, $p < 0.01$ and $r = 0.738$, $p < 0.001$, respectively). **Conclusion.** A large percentage of children with cerebral palsy were not able to establish control over the position of articulatory organs, especially the tongue, and its retention in a given position, all of which affect the quality of speech.

Key words:

speech disorders; cerebral palsy; tongue; speech articulation tests; child.

Apstrakt

Uvod/Cilj. Govor predstavlja veliki problem kod dece sa cerebralnom paralizom. Govor te dece je manje ili više razumljiv u zavisnosti od stepena redukovane pokretljivosti artikulacijskih organa. Na smanjenu pokretljivost jezika utiču i nemogućnost kontrole facijalnih grimasa i slaba mišićna snaga prilikom izvođenja ciljanih pokreta. Cilj ovog istraživanja bio je da se utvrdi pokretljivost jezika kod bolesnika sa cerebralnom paralizom. **Metode.** Ispitivanjem je bilo obuhvaćeno 34 dece sa cerebralnom paralizom koja su bila na lečenju u Specijalnoj bolnici za cerebralnu paralizu i razvojnu neurologiju u Beogradu. Deca, uzrasta 8–12 godina, imala su očuvane intelektualne sposobnosti i sluh. Deca su bila podeljena na dve grupe prema dijagnozi: *Quadriparesis spastica* bila je zastupljena kod 18 dece, a *Morbus Little* kod 16 dece. Ispitivanje je obavljeno u periodu od januara do septembra 2009. godine. Funkcionalno stanje artikulacijskih organa kod obe grupe bolesnika ispitano je C-testom, koji utvrđuje pokretljivost jezika. **Rezultati.** Naše istraživanje pokazalo je narušeno funkcionalno stanje jezika kao najpokretljivijeg artikulatora kod obe grupe bolesnika. Znatno više bila su ugrožena deca sa dijagnozom *Quadriparesis spastica*. Nađena je značajna korelacija između funkcijskog stanja jezika i dijagnoze ($r = 0,594$; $p < 0,005$), kao i između izvođenja proba jezikom i dijagnoze ($r = 0,816$; $p < 0,001$). Takođe, nađena je značajna korelacija između dijagnoze i zadržavanja jezika u zadatom položaju ($r = 0,738$; $p < 0,001$). **Zaključak.** Utvrđeno je da visok procenat dece sa cerebralnom paralizom nije u mogućnosti da uspostavi kontrolu položaja artikulacijskih organa, pre svega jezika, kao i njegovo zadržavanje u zadatom položaju, što sve skupa utiče na kvalitet govora.

Ključne reči:

govor, poremećaji; paraliza, cerebralna; jezik; govor, testovi artikulacije; deca.

Introduction

“Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and behaviour, by epilepsy, and by secondary musculoskeletal problems”¹.

Optimistic expectations that the constant progress of science and neonatal diagnosis would decrease the incidence of cerebral palsy, have not come true. The incidence of cerebral palsy is 1.5–2.5 per 1 000 live births². The cure has not yet been found, so we need to observe current state of each patient individually in a way to help him/her in overcoming the difficulties caused by this disease³. Bax⁴ suggests that in these patients skeletal muscles, as well as chewing, swallowing and speech muscles are affected by basic pathological processes that cause the difficulties in articulation. In children with cerebral palsy, there is insufficient mobility of the muscles of individual speech organs involved in the process of articulation. It is generally known that there is no good quality speech without good functional state of the articulation apparatus. The tongue is an organ that is most important articulator. It is located in the oral cavity and plays an important role in chewing, swallowing, sucking and speech. The tongue represents the muscle structure, fan-like spread, and is one of the most mobile organs. Anatomically, the tongue is divided in two parts, the front or the horizontal and the back or the vertical part (tongue basis). The front of the tongue is attached to the center line of the mouth (*frenulum linguae*), and sometimes can be so short that prevents normal movement of tip of the tongue, making articulation more difficult⁵. The tongue has the motor, sensitive, gustatory and tactile innervation. It receives motor innervation over the twelfth cerebral nerve (*nervus hypoglossus*). Field of innervation is strictly divided, right *hypoglossus* innervates the right side, and left *hypoglossus* the left side of tongue. This is clinically important because of the unilateral nerve lesions that lead to muscle atrophy, and thus a mobility reduction of the appropriate side of the tongue⁶. For the voice articulation both motor and sensitive innervation are very significant. The tongue is a three-dimensional muscle which can move to the three main directions owing to the action of the external muscles. The external muscles enable motions upward – forward, upward – backward and downward – backward while the internal muscles enable shapes change of the tongue at any position⁷. By the contraction of these muscles the tongue can be made shorter, narrower, can bend at any directions, the gutters can be made and alike.

The aim of this study was to determine the condition of articulatory organs of certain groups of patients with cerebral palsy, ie. the mobility of tongue as one of the most important articulators.

Methods

The study included a sample of 34 children with cerebral palsy who had been treated in the Special Hospital for Cerebral Palsy and Developmental Neurology in Belgrade. The children, aged of 8–12 years, had preserved intellectual abilities, and hearing. The children were divided into two groups according to the diagnosis: *Quadripareisis spastica* was diagnosed in 18 patients, and *Morbus Little* in 16. This age was chosen because in eight-year-old children the automation of the articulation basis was finished. The study was conducted in a period from January to September 2009. The functional state of articulation organs in both groups was tested by the C-test that examines anatomic structure and mobility of the articulation organs⁸. The software package SPSS-16 was used for making a database. For processing the obtained data appropriate statistical methods were used.

Results

Examination of functional state of the tongue showed that in the group diagnosed with *Morbus Little* 50% of the children had normal tongue condition, 37.5% of them had hypertonic tongue, 6.25% spastic and 6.25% hypotonic (Table 1). In the children with *Quadripareisis spastica*, 33.33% of them had hypertonic tongue, 38.89% spastic, 27.78% atrophic, while normal and hypotonic state of tongue were not found.

Table 1
The functional state of the tongue in both groups of children

Functional state of the tongue	Children diagnosed with			
	<i>Morbus Little</i>		<i>Quadripareisis spastica</i>	
	n	%	n	%
Normal	8	50.00	0	0.00
Hypertonic	6	37.50	6	33.33
Spastic	1	6.25	7	38.89
Hypotonic	1	6.25	0	0.00
Atrophic	0	0.00	5	27.78
Total	16	100.00	18	100.00

$r = 0.594$ (Pearson's correlation coefficient); $p < 0.005$

Some tongue tests were performed by using C-tests. Accuracy and time required for performing certain movements were measured in both groups of the patients. In *Morbus Little* group testing was normally performed by 43.75% of the patients, 43.75% of patients have delayed test performance and 12.5% incorrect (Table 2). In the children with *Quadripareisis spastica* 38.89% of them incorrectly performed the test, with delay 5.56%, and 55.56% of them were not able at all to adequately perform fine and precise articulation movements.

We tested retention of the tongue in a given position, examining that way its muscle strength, and we did not come to optimistic results. In the group diagnosed with *Morbus Little* only 31.25% of the patients normally retained the tongue in a given position, 56.25% did it with difficulty, while 12.5% were not able to retain the tongue at all (Table 3). In the group

Table 2
The tongue test performance in both groups of children

Tongue test performance	Children diagnosed with			
	<i>Morbus Little</i>		<i>Quadriparesis spastica</i>	
	n	%	n	%
Normally	7	43.75	0	0.00
Slowly	7	43.75	1	5.56
Incorrectly	2	12.50	7	38.89
Unable to perform	0	0.00	10	55.56
Total	16	100.00	18	100.00

$r = 0.816$ (Pearson's correlation coefficient); $p < 0.001$

Table 3
The ability to retain the tongue in both groups of children

Tongue retention in determined position	Children diagnosed with			
	<i>Morbus Little</i>		<i>Quadriparesis spastica</i>	
	n	%	n	%
Normally	5	31.25	0	0.00
With difficulty	9	56.25	2	11.11
Unable to perform	2	12.50	16	88.89
Total	16	100.00	18	100.00

$r = 0.738$ (Pearson's correlation coefficient); $p < 0.001$

of patients diagnosed with *Quadriparesis spastica* the results were much worse, even 88.89% of patients were not able to retain the tongue in a given position, and only 11.11% of them performed retention, but with great effort.

Discussion

Scientific community has focused attention on dysarthria as a global problem of this population and the consequences deriving from it, especially unintelligible speech. Strauss et al.⁹ have found that estimations based on a simple, easily measurable functions, such as lead pose, ability for taking food, quality of articulation and speech intelligibility, can lead to valuable information about this disease forecasting. Our research showed functional state of the tongue as the most mobile articulator is impaired in both groups of the patients. But generally, functional state of tongue was significantly worse in patient diagnosed with *Quadriparesis spastica*. The correlation between functional state of the tongue and the diagnosis was $r = 0.594$, $p < 0.005$.

When performing the tongue test, 43.75% of the patients diagnosed with *Morbus Little* managed to accomplish the test. In the group with *Quadriparesis spastica* no patient was able to fully carry out the task. The limitation of tongue mobility may be associated with spasm of tongue and chin muscles¹⁰. Active movements were more limited in children with *Quadriparesis spastica*, because in these patients both the lower and the upper limbs muscles were affected by spasms including orofacial muscles, while in patients with *Morbus Little* motor deficit was mostly associated with the lower limbs. The correlation between tongue test performance and the diagnosis was significant ($r = 0.816$, $p < 0.001$).

A motor deficit of orofacial muscles is often accompanied by poor muscle strength of the tongue. Retaining the

tongue in a certain position somewhat showed better results in the patients diagnosed with *Morbus Little*, indicating that this articulatory organ in children with cerebral palsy in addition to impaired innervation is accompanied by extremely weak muscle strength, all of which results in poor sounds, articulation that requires active participation of the tongue along with other structures. There was a significant correlation found between the diagnosis and retention of tongue in a given position ($r = 0.738$, $p < 0.001$).

This study is strictly related to motor deficits of the tongue as articulation organ in children with cerebral palsy and preserved intelligence and it is the first research of this type conducted in Serbia. Although the sample is small, we hope that the research will contribute to better understanding of articulation problems of this population and help in taking appropriate and timely habilitation measures for their reducing. Platt et al.¹¹ conducted a similar research, but it included adults of reduced intelligence quotient with cerebral palsy.

Conclusion

After analyzing the results obtained by this study it could be concluded that both groups of the patients had impaired functional condition of the tongue, decreased ability to perform certain movements and weaker tongue muscles strength. The worse results were obtained in the children diagnosed with *Quadriparesis spastica*. Therefore, they had less control of articulation apparatus, increased salivation and less intelligible speech. The facts indicate that immediately after making the diagnosis, it is necessary to include these children in an early habilitation treatment, well before the automation of articulation, so that the mechanisms of neuroplasticity could help them build basic levels of speech functions.

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