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ORIGINAL ARTICLE – OPEN ACCESS

A Comparison of Prenatal, Natal, and Postnatal Histories in Children with Cerebral Palsy with and without Swallowing Disorder

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ABSTRACT

Objective: In children with suspected cerebral palsy (CP) after birth who are followed up, the possibility of swallowing disorder should also be considered from the early stages and should be evaluated on a regular basis. The aim of the study was to compare the prenatal, natal, and postnatal histories in children with CP with and without swallowing disorder.

Materials and Methods: Children with CP who were between 2 and 16 years old and who were currently subjected to oral feeding were evaluated. The demographic characteristics and natal histories of the children were noted by asking their caregivers. The 3-ounce water swallow test was used in swallowing evaluation.

Results: On the basis of the results of the water swallow test, 46 children were divided into two groups: those who had no swallowing disorder (n=15) and those who had swallowing disorder (n=31). The groups were similar in terms of histories between the prenatal period and natal period ($p>0.05$). Postnatal histories, including gagging after sucking, weight loss, chewing problem, and head control, were different between groups ($p=0.024$, $p=0.001$, $p=0.001$, and $p=0.047$, respectively).

Conclusion: It is important to evaluate the postnatal symptoms and motor development of children with CP who have swallowing disorders during follow-up.

Keywords: Cerebral palsy, dysphagia, prenatal, natal, postnatal histories

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INTRODUCTION

Feeding and swallowing disorders, as well as motor, cognitive, sensory, and speech problems, can be seen in children with cerebral palsy (cwCP), which is known as brain damage acquired in the prenatal or perinatal period (1).

Swallowing problems in cwCP may be described as oropharyngeal dysphagia. The main complications of oropharyngeal dysphagia include ineffective bolus transport, delayed swallow initiation, drooling, respiratory infections, and aspiration pneumonia (2). Feeding problems, together with prolonged feeding times or chewing problems, may lead to inadequate growth (3). Both feeding and swallowing disorders in cwCP can cause malnutrition, dehydration, and even recurrent pulmonary complications. The severity of swallowing disorders varies over time, which may be associated with sensorimotor disorders, gross motor dysfunction, and cognitive disorders (3). Feeding and swallowing problems can also arise from a variety of structural issues, including scoliosis and kyphosis, that occur in the child's body due to neurodevelopmental disorder (4).

In children with suspected CP after birth who are followed up, the possibility of swallowing disorder should also be considered from the early stages and should be evaluated on a regular basis. Sanchez K. et al. (5) showed that factors such as low birth weight, preterm birth, and the localization of brain damage, which are among the factors observed in the natal period, are associated with swallowing disorders in cwCP. Four main factors, namely, feeding time, stress during feeding, weight gain, and respiratory problems, were determined for the detailed evaluation of feeding/swallowing disorders in cwCP (3). However, all of these factors are postnatal factors. Crapnell TL. et al. (6) showed the relationship between the low socioeconomic level of the family and malnutrition in preterm infants. The factors associated with feeding/swallowing disorders in cwCP have been evaluated in different ways (7).

The purpose of this study was to compare the prenatal, natal, and postnatal histories in children with CP with and without swallowing disorders. It was hypothesized that natal histories in cwCP who suffer from swallowing disorders are different from natal histories of those without swallowing disorders.

MATERIALS and METHODS

Participants

This descriptive and cross-sectional study was carried out at the Department of Physical Therapy and Rehabilitation of a university hospital between June 2019 and January 2020. The study was approved by the Non-invasive Clinical Research Ethics Committee of Hacettepe University (Approval date: 11.06.2019/Approval number: GO19/643). We obtained written informed consent from each participant's family.

Children with a diagnosis of CP who were between 2 and 16 years old and who currently had oral feeding were included in the study. Those with any other neurodegenerative problems were excluded.

Procedure

The evaluation of the outcome measures was carried out by the same physiotherapist in the morning in a quiet, well-lit room.

Demographic features and natal history: The demographic characteristics of the children and their natal histories were recorded with the parent report.

In the prenatal histories, the mother's gestational age and mother's condition during pregnancy (i.e., past illnesses, high fever, exposure to radiation, and smoking during pregnancy) were questioned.

Prematurity, birth weight, asphyxia at birth, status of staying in an incubator, natal breathing problem, and natal seizure were questioned in terms of natal histories.

Postnatal history of respiratory problems, concussion, lung infection, feeding difficulty, coughing after sucking, voice change after sucking, respiratory problems after sucking, gagging after sucking, vomiting after sucking, weight loss, chewing problems, and normal motor developmental stages (head control, turning, sitting, crawling, and walking) were questioned. In addition, the presence or absence of oral structural problems such as a high palate, open mouth, tongue thrust, or open bite was noted.

Gross Motor Function Classification System (GMFCS): The functional motor level can be categorized using the GMFCS into five groups from Level I to Level V. The GMFCS is a valid and reliable system in cwCP (8).

Clinical Swallowing Evaluation (CSE): The 3-ounce water swallow test was performed as CSE. The test is performed routinely in clinics to obtain information regarding the swallowing performance of the patient (9). Each child was given 3 ounces of water (90 cc) and was asked to drink from a cup without interruption, and the results were recorded. The criteria for test failure were the inability to drink the entire amount and coughing/choking during or up to 1 min after completion. Those who passed the test were allocated in the group with no swallowing disorder, and those who failed the test were allocated in the group with swallowing disorder.

Statistical Analysis

The sample size was calculated using the G*Power package software program (G*Power, Version 3.0.10, Franz Faul, Universität Kiel, Germany). On the basis of this calculation, 46 children with CP were included, with a 5% type I error margin and 78% statistical power.

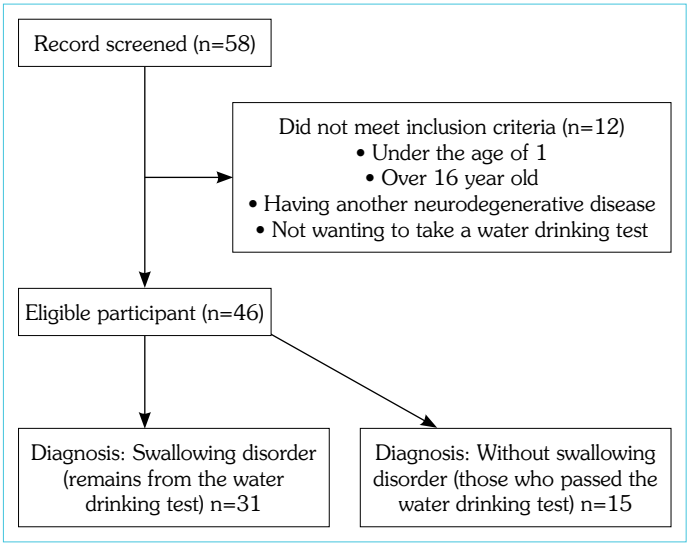

Figure 1. Consort flow diagram of participant selection during the 3-ounce water swallow test

The obtained data were analyzed using IBM SPSS Statistics 15.0 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). All data were checked for normal distribution using the Shapiro-Wilk test, and descriptive statistics were calculated for the variables. The non-normally distributed data were presented as median with quartiles (Quartile 1 and Quartile 3), and ordinal variables were presented as frequency and percentage. The chi-square test or Fisher's exact test (when chi-square test assumptions do not hold because of low expected cell counts) or the Mann–Whitney U test, where appropriate, was used to compare variables in children with/without swallowing disorders. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 58 children with CP were screened for the study, and the final analysis was performed with 46 children (Fig. 1). On the basis of the results of the 3-ounce water swallow test, 46 children were divided into two groups: children who had no swallowing disorder (n=15) and those who had swallowing disorder (n=31). The descriptive characteristics are shown in Table 1. Weight (p=0.014), GMFCS levels (p=0.013), motor developmental levels (p=0.047), and topographic location (p=0.010) were different between groups.

In terms of histories from the prenatal period, there was no difference between groups, including the mother's gestational age, smoking during pregnancy, exposure to radiation during pregnancy, and high fever during pregnancy (p=0.832, p=0.213, p=0.592, and p=0.709, respectively).

Groups were similar in terms of natal period characteristics such as gestational week and birth weight (p>0.05) (Table 2).

Postnatal histories, including weight loss, head control, gagging after sucking, chewing problem, and tongue thrust, were different between groups (p=0.024, p=0.001, p=0.001, p=0.047, and p=0.005, respectively) (Table 3).

Table 1. Demographic and clinic features of the patients

	Children without swallowing disorder		Children with swallowing disorder		p
	Median	Q1–Q3	Median	Q1–Q3	
Age (years)	6	4–10	5	3–7	0.363
Weight (kg)	22	14–24	13	11–21	0.014*
Height (cm)	110	93–130	97	87.5–110	0.061
GMFCS	**n**	**%**	**n**	**%**	
I	3	20	0	0	0.013*
II	5	33.3	7	22.6	
III	1	6.7	1	3.2	
IV	2	13.3	5	16.1	
V	4	26.7	18	58.1	
Motor developmental level					0.047*
Apedal	5	33.3	19	61.2	
Quadripedal	3	20	6	19.4	
Bipedal	7	46.7	6	19.4	
Topographic location					0.010*
Hemiplegic	4	26.7	6	19.4	
Diplegic	9	60.0	5	16.1	
Quadriplegic	2	13.3	20	64.5	

*: P<0.05; GMFCS: Gross Motor Function Classification Systems; Q1: Quartile 1; Q3: Quartile 3; n: Number

DISCUSSION

Swallowing disorders should be followed up routinely in infants and children because of possible swallowing-related complications and its effects on child's growth and development. After taking patient history thoroughly during these follow-ups, swallowing can be evaluated using different clinical methods. Therefore, we compared the natal histories of cwCP with and without swallowing disorder. Our hypothesis was that the prenatal, natal, and postnatal histories would be different between groups. However, groups were found to be similar, except for gagging, weight loss, chewing problem, and head control parameters, which did not fully support our hypothesis.

It is important to correctly identify and properly manage dysphagia, especially in pediatric groups with neurodevelopmental disorders, such as CP (10). Detailed history taking in children should cover prenatal, natal, and postnatal periods. Prenatal history mostly includes questions regarding the mother and family history. These problems are factors related to the child's neurodevelopmental disorder, in addition to swallowing disorders (11). Prenatal and natal histories were similar between groups, agreeing with the results reported by Patel DR. et al. (11). However, we believe that findings regarding sucking are particularly important in postnatal history. In addition, in this current study, the fact that the two groups were similar in parameters other than gagging after sucking, weight loss, chewing problems, and head control suggests that the history after the transition to additional food is important for swallowing disorders in CP. It also supports Matsuo K. et al. (12), who reported that bolus texture is a key factor for safe swallowing in patients with dysphagia as improper bolus texture may result in aspiration and/or pharyngeal residue.

"Weight gain/loss" (13), which is one of the crucial elements considered in the follow-up of normal development in healthy babies, is an important parameter that should be questioned in the detailed evaluation of the possibility of swallowing/nutritional disorders in cwCP (3). It is stated that the follow-up of weight loss in cwCP is evaluated not only in terms of malnutrition but also in terms of the effects on children's participation in social activities and on rehabilitation by causing delays in motor functions (14). Huysentruyt K. et al. (15) reported that one-third of cwCP with a GMFCS of 5 were underweight, and the rate of swallowing disorder increased in those with a GMFCS of 2 and above. In our study, we thought that weight monitoring was important from the early period by questioning the postnatal weight loss in the history of the child, and our results supported our hypothesis. In our study, weight loss was significantly different between children with swallowing disorder and those without. Further, the fact that 58.1% of the group with swallowing disorder had a GMFCS level of V, and the difference in the GMFCS between groups supports the literature.

In CP, motor development delays due to decreased muscle strength and coordination and sensory and cognitive impairments (16). In a detailed history, developmental steps must be questioned. In the clinical evaluation of the motor development stages of the cwCP, child's head control is evaluated at first. With the development of the postural mechanisms of the central nervous system, infants try to keep their heads upright (17). A good head control requires the activation of sensory receptors from the head and inhibition of primitive and pathological reflexes to achieve trunk stability and to perform functional activities (nutrition, dressing, etc.) (18). Conversely, the lack of head control increases feeding/swallow-

Table 2. Comparison of pre-natal and natal histories between groups

	Children without swallowing disorder		Children with swallowing disorder		p
	Median	**Q1–Q3**	**Median**	**Q1–Q3**	
MGA (years)	30	22–35	30	23–33	
	n	**%**	**n**	**%**	
Pre-natal histories					
Smoking during pregnancy	0	0	3	9.7	0.213
Exposure to radiation	1	6.7	1	3	0.592
High fever during pregnancy	2	13.3	3	9.7	0.709
Prematurity					0.472
Term	7	46.7	14	45.2	
Late preterm	–	–	4	12.9	
Very preterm	4	26.7	5	16.1	
Extremely preterm	4	26.7	8	25.8	
Birth weight (gr)					0.762
<2500	7	46.7	13	41.9	
>2500	8	53.3	18	58.1	
Asphyxiation	6	40.0	15	48.4	0.592
Staying at Incubator	8	53.3	16	51.6	0.913
Natal breathing problem	5	33.3	15	48.4	0.334
Natal seizure	5	33.3	11	35.5	0.886

gr: Gram; MGA: Mother's gestational age; Q1: Quartile 1; Q3: Quartile 3; n: Number

ing disorders and drooling problems, and changes the child's independence level. In a study, a negative relationship between head control and drooling problem was reported (19). It has also been reported that feeding/swallowing disorders and drooling problems are common in cwCP (20). In our study, the difference between groups with and without swallowing disorder in terms of head control in the postnatal histories supports the literature.

Sucking and swallowing functions, which are critical components of the infant's motor repertoire, are essential for successful intake, growth, and development (21). Therefore, one of the important parameters in the evaluation of swallowing/feeding disorders in children is the behavior of the child during sucking. Sucking and swallowing problems have been observed in those with brain damage in the neonatal period (22). In a follow-up study by Murray DM. et al. (22), in which data were collected at discharge and on postnatal months 6, 12, and 24, it was reported that the neurological examination performed at discharge was associated with the child's subsequent oral feeding ability. Stating a different opinion on this issue, Selley WG. et al. (23) reported that there was no relationship between sucking pattern and swallowing problem in cwCP with swallowing problems. In this study, when we compared parameters such as gagging during sucking, coughing after sucking, voice change after sucking, vomiting after sucking, and respiratory problems after sucking between groups with and without swallowing disorder, we found that only the history of gagging during sucking was different between the groups. During sucking, gagging is a result of the gag reflex. However, the gag reflex is a protective reflex, being hyperactive in the early period may be a sign of sucking/swallowing problem, but it is not a sufficient symptom on its own (24). In addition, it is contradictory that there is a direct relationship between the gag reflex and swallowing disorder, which has not been clearly demonstrated in studies (3, 25). Although it is known that voice change after sucking is an important parameter in the suspicion of dysphagia, there was no difference between our groups. However, the fact that the voice change after sucking was observed in only three infants in the group without swallowing disorder shows its clinical importance. Reports regarding respiratory problems after sucking, another parameter of ours, are contradictory. There are studies stating that conditions such as receiving long-term respiratory support in the NICU and feeding with NG cause feeding and swallowing problems later (26), and there are those arguing the opposite (5). Crapnell TL. et al. (6) followed preterm infants for 2 years and reported that taking respiratory support in the neonatal unit did not cause feeding problems, which is in line with our results. When we examined the histories of those with swallowing problems in our study, we observed that the rate of receiving respiratory support was not different between the two groups. These contradictory interpretations in the literature may be due to the varying conditions of neonatal care units. In addition, we thought that delays in normal motor development such as head control may be more effective in dysphagia.

Chewing is one of the main markers of oral motor functions, and in clinical evaluation, information can be obtained from families as "with/without chewing problems" (27), and it can be evaluated observationally with different batteries (28). According to the infor-

Table 3. Comparison of post-natal histories between groups

	Children without swallowing disorder		Children with swallowing disorder		
	n	%	n	%	p
Lung infection	1	6.7	8	25.8	0.235
Feeding difficulty	5	33.3	15	48.4	0.334
Coughing after sucking	4	26.7	19	61.3	0.421
Change in voice after sucking	3	20	12	38.7	0.317
Breathing difficulty after sucking	3	20	11	35.5	0.331
Gagging after sucking	1	6.7	12	38.7	0.024*
Vomiting after sucking	8	53.3	18	58.1	0.762
Weight loss	0	0	16	51.6	0.001*
Chewing problem	3	20	23	74.2	0.001*
Tongue thrust	1	6.7	15	48.4	0.005*
Head control					0.047*
On time	5	33.3	3	9.7	
Delayed	10	66.7	28	90.3	
Turning					0.095
On time	3	20.0	30	96.8	
Delayed	12	80.0	1	3.2	
Unsupported sitting					0.244
On time	2	13.3	1	3.2	
Delayed	13	86.7	30	96.8	
Crawling					0.326
On time	1	6.7	0	0	
Delayed	14	93.3	31	100.0	
Walking					0.978
On time	1	6.7	2	6.5	
Delayed	14	93.3	29	93.5	

*: P<0.05

mation obtained from the families, it is stated that approximately 26% of cwCP have difficulty chewing solid foods and chewing problems can be seen up to 41% in cwCP with a high GMFCS level (29). It has been shown that there is a positive relationship between chewing problem and swallowing disorder in cwCP. The difference in chewing between the two groups in our study supports the literature. Increasing the variety of nutrition with solid foods has an important contribution to the development of the child. Transition to solid food and gaining chewing function are delayed in cwCP, and chewing is mostly not functional (30). This outcome also causes swallowing disorder due to the insufficient food chewing practices (12). From this point of view, we thought that one of the most important parameters to be questioned in the measurement of swallowing functions in cwCP is the chewing function, which was confirmed by our results.

In the current study, CSE was performed for the evaluation of swallowing performance. However, after instrumental evaluations if possible, a more objective test method such as the Videofluoroscopic Swallowing Study could also be performed to support current findings. In addition, we thought that our results can be strengthened with detailed analysis with larger patient groups.

CONCLUSION

Swallowing disorders in pediatric populations can have a negative impact on growth and development. It is important to inquire regarding the child's prenatal, natal, and postnatal histories during swallowing evaluation. In the current study, we found that cwCP who had swallowing disorders had more postnatal problems, which highlights the importance of the history taken for swallowing evaluation.

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Ethics Committee Approval: The Hacettepe University Non-Interventional Clinical Research Ethics Committee granted approval for this study (date: 11.06.2019, number: GO19/643).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – NÖÜ, SSA; Design – NÖÜ, SSA; Supervision – NÖÜ; Data Collection and/or Processing – NÖÜ; Analysis and/or Interpretation – NÖÜ, SSA; Literature Search – NÖÜ; Writing – NÖÜ, SSA; Critical Reviews – NÖÜ, SSA.

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