Temporal measurements of oral transit time in children with cerebral palsy of different levels motors and the relationship with the severity of dysphagia

Medidas de tempo de trânsito oral em crianças com paralisia cerebral de diferentes níveis motores e sua relação com o grau de severidade para disfagia

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ABSTRACT

Purpose: To verify the oral transit time in children with cerebral palsy, and relating it to the degree of dysphagia severity and motor level. Methods: The sample was 50 children with cerebral palsy, 23 males and 27 females, mean age of 3 years 7 months. The clinical assessment consisted in to provide food in liquid and pasty consistency. It measured the time of oral transit, and performed the diagnosis of swallowing function classifying it into normal, mild, moderate or severe dysphagia. Results: The mean of oral transit time was found to be 1.33 seconds to liquid and 3.33 seconds for pasty consistency. As higher the level of the motor group of children, higher the time for swallowing liquid consistency, which was statistically significant. Statistically significant difference was found between groups for both consistencies, with a progressive increase of the time in accordance with the increase in impairment of swallowing. Conclusion: The oral transit time in children with cerebral palsy was found increased and may represent the severity of dysphagia presented, because this time was longer as worse the impairment in swallowing function. The higher the overall motor impairment presented, the longer oral transit time.

Keywords: Cerebral palsy; Deglutition disorders; Time; Deglutition; Child

RESUMO

Objetivo: Verificar o tempo de preparo e de trânsito oral da deglutição de crianças com paralisia cerebral e relacioná-lo ao grau de severidade da disfagia e ao nível motor, de acordo com o Gross Motor Function Classification System. Métodos: Participaram desta pesquisa 50 crianças com paralisia cerebral, média de idade de 3,6 anos, sendo dez crianças de cada nível motor. A avaliação fonoaudiológica clínica da deglutição consistiu na oferta de alimentos nas consistências “líquido fino” (água) e “pastoso homogêneo” (iogurte tipo petit suisse). Foi mensurado o tempo de preparo e de trânsito oral e realizado o diagnóstico da função de deglutição, classificando-a em normal, disfagia leve, moderada, ou grave. Resultados: A média do tempo de deglutição foi de 1,33 segundos para a consistência líquida e de 3,33 segundos para a consistência pastosa. Quanto maior o nível motor do grupo de crianças, maior o tempo de deglutição para a consistência líquida. Encontrada diferença significativa entre os grupos para as duas consistências, com aumento progressivo do tempo de deglutição quanto maior o comprometimento da função de deglutição. Conclusão: O tempo de trânsito oral em crianças com paralisia cerebral mostrou-se aumentado e pôde representar a gravidade da disfagia apresentada, já que esse aumento ocorreu conforme maior o comprometimento da função de deglutição. Quanto maior o comprometimento motor global apresentado, maior o tempo de trânsito oral.

Descritores: Paralisia cerebral; Transtorno de deglutuição; Tempo; Deglutição; Criança
INTRODUCTION

Cerebral palsy (CP) is a group of permanent disorders of the development of movement and posture, causing activity limitations that are attributed to nonprogressive disturbances that occur in the brain in childhood development. Children with neuromotor disorders, as in the CP, frequently present problems in swallowing function, leading to clinical disorders, including recurrent pneumonia and malnutrition. The CP is associated to the complex orofacial sensorimotor dysfunction, including dysphagia, dysarthria, alterations in chewing and drooling. Study conducted with 1357 children with CP of several global motor impairment, found that 21% of these children had alterations in the functions of swallowing and/or chewing, and 22% excessive escape of saliva.

In CP, dysphagia is often characterized by changes in the oral phase, voluntary motor activities, and pharyngeal with active order reflexive swallowing. Among the disorders in swallowing function, one of the most frequently refers to the increase in oral transit time, leading to greater energy expenditure during oral intake, worsening the maintenance and weight gain in children. Authors found in their study that the stages of oral phase, both in the clinical assessment, as in videofluoroscopy of swallowing, are altered in children with CP spastic quadriplegia. In children with CP, the presence of dysphagia is associated with delayed development, malnutrition and short stature.

Due to the nutritional impact resulting from increased oral transit time, it is necessary to know about the time that children with cerebral palsy exhibit, and correlated it with the severity of dysphagia. As the oral transit time is relevant in relation to pathophysiology of swallowing, since it can show the wear to the task and, moreover, relates the disorders in oral preparation, knowing it results in an important data for the evaluation of children with neuropathy, attempting to demonstrate in a more quantitative manner, the significance of swallowing deficit in this population.

The more elements will be able to be measured in a clinical and quantitative evaluation, greater facility the speech therapist will have to classify the deglutition disorders presented in children with neuropathy, including set targets and defining better the goals and prognosis for each patient.

Among the methods of measuring time in swallowing function, there are those using videofluoroscopy of swallowing, which makes this process more effective, since objective images are used, making it possible to determine, with greater precision, the time at which the reaction of swallow happens. However, in many services the availability of videofluoroscopy is still small, indicating the need to measure the time of preparation and conducting oral in a clinical form.

Thus, this study aimed to verify clinically the time of the transit oral in children with CP, and relating it to the degree of dysphagia severity and motor level according to the Gross Motor Function Classification System (GMFCS).

METHODS

This study was approved by the Research and Ethics Committee for Associação de Assistência à Criança Deficiente (AACD), protocol number 12/2011. All responsible for children signed the term of free and informed consent authorizing the participation in this study.

The sample was 50 children with CP who attend the Rehabilitation Center of AACD, 23 males and 27 females, aged from 1 year and 7 months to 4 years and 11 months (mean age of 3 years and 7 months).

For increased the knowledge of oral transit time in children with CP, taking into account their different global motor impairment, we chose to select ten children each motor level, according to the GMFCS. The GMFCS is based on the movement initiated voluntarily by the child, emphasizing particularly the seat (trunk control) and walk. Presents five levels, which, briefly, are: Level I: the children sit on the floor with both hands free to manipulate objects. The movements of sitting and getting up from the floor are performed without adult assistance. Children move about walking - because just prefer, without the need for any auxiliary apparatus; Level II: the children sit on the floor, but may have difficulty with balance when both hands are free to manipulate objects. The movements of sit and let the sitting position are performed without adult assistance. Children move about walking - because just prefer, without the need for any auxiliary apparatus; Level III: children remain seated on the floor, often in the position of W (sit between the hips and knees in flexion and internal rotation) and may require adult assistance to assume sitting position. Can walk short distances in the internal spaces, using assistive mobility devices, needing adult assistance to direct them and turn them; Level IV: the children sit on the floor when well placed on, but are unable to maintain alignment and balance without using your hands for support. Move about rolling over short distances, creeping or crawling in prone (on his hands and knees) without reciprocating movement of legs; Level V: the physical impairments restrict voluntary control of movement and the ability to maintain antigravity head and trunk. All areas of motor function are limited. At this level, children have no means of independent mobility and need to be transported.
Exclusion criteria of this study: presenting pathologies associated with CP; make use exclusive or partial feeding tubes; present restrictions to intake of any of the components or consistency of foods offered, presenting cleft lip and/or palate.

Clinical evaluation of swallowing consisted in offering food in consistencies of “thin liquid” (water) and “pasty homogeneous” (yogurt petit suisse) by the child’s caregiver, if they could not feed herself, in the usual posture and with the usual eating utensils (spoons and cups).

The volume of each offering was up to the caregiver/subject, according to the child’s eating routine. The volume to be provided influences the physiology of swallowing displayed, but the authors preferred to keep offering the routine of each patient, avoiding alterations in dynamics. Also, select a specific volume for the evaluation would cause, in many cases, a need for reduction of the offered volume. Also, changing the usual eating utensil, which in children with neuropathy significantly alters the function of swallowing. Were performed at least two offers for each consistency, starting with the liquid since the pasty consistency is more likely to occur stasis of the bolus in the pharyngeal region.

During the intake, were measured the time for preparation and oral transit, which includes the period of time when the food is placed in the oral cavity until its first swallowing. The time was measured using the digital stopwatch Herweg® 8905-34 and was considered the result of the mean time of the two swallows presented for each food consistency offered.

At the same moment, the child received the diagnosis of swallowing function, according to the clinical evaluation of swallowing, classifying it as normal, mild, moderate or severe dysphagia. This classification was done at the AACD in São Paulo, and due the lack of severity ratings of dysphagia in children with neuropathy that cover the data of preparation, organization and oral transit time, as clinical signs of laryngeal penetration and/or tracheal aspiration, the authors opted to maintain this rating, describing what they considered in each item. Also, keep the routine classification of the expertise in pediatric dysphagia, provided greater reliability of the results of this study. The classification, then, followed these criteria:

- Normal: efficient capture in removing the food from the utensil; absence escape extraoral; efficiency in preparing the bolus at the expected time; absence of residues in the mouth after swallowing, or small volume, spontaneously removed next swallowing; clean cervical auscultation; no clinical signs suggestive of laryngeal penetration and/or tracheal aspiration.
- Mild dysphagia: capture not effective for removing the food from the utensil; presence of escape extraoral to half volume given; inefficiency in preparing the bolus at the expected time; residues in the mouth after swallowing, at any volume, with no clearance or partial clearance in the next spontaneous swallowing; clean cervical auscultation; absence of clinical signs suggestive of laryngeal penetration and/or tracheal aspiration.
- Moderate dysphagia: capture not effective for removing food from the utensil; escape extraoral presence of more than half the volume given; inefficiency in preparing the bolus in the time expected; residues in the mouth after swallowing, at any volume, with no clearance in swallowing spontaneously; noisy cervical auscultation, with noise clearance after next swallowing; clinical signs suggestive of laryngeal penetration and/or tracheal aspiration such as coughing and throat clearing, with apparent clearance of the airways.
- Severe dysphagia: capture not effective for removing food from the utensil; escape extraoral presence of more than half the volume given; inefficiency in preparing the bolus at the expected time; residues in the mouth after swallowing, at any volume, with no clearance in swallowing spontaneously; cervical auscultation noisy without clearance the noise; presence of clinical signs suggestive of laryngeal penetration and/or tracheal aspiration without apparent clearance airway.

**Statistical analysis**

The Jonckheere-Terpstra test was applied to detect differences between the five motors levels and the diagnoses of dysphagia, when compared simultaneously, to the variables of time in both food consistencies offered. The data obtained were compared with the literature. Fixed at 0.05 or 5% the significance level.

**RESULTS**

The mean time for swallowing to the 50 children of this study was 1.33 seconds for the liquid consistency and 3.33 seconds for the pasty. The higher the motor level, that is, the more severe motor impairment, longer the time for swallowing in liquid consistency, with a significant difference (p<0.001) between groups. To paste consistency, the difference found between the groups was statistically similar (Table 1).

In the data analysis of the swallowing time, according to the degree of severity of the swallowing impairment, difference was verified (p<0.001) between the groups, with progressive increase in the time of swallowing, the more severe the impairment of swallowing function. In the analysis of paste consistency, difference was also found (p<0.001) between the
Table 1. Oral transit time, in seconds, of children with cerebral palsy, in the liquid and pasty consistencies, according to motor level by the GMFCS

<table>
<thead>
<tr>
<th>Consistency</th>
<th>Motor level</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid</td>
<td>I</td>
<td>10</td>
<td>0.62</td>
<td>0.25</td>
<td>0.26</td>
<td>1.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>10</td>
<td>0.98</td>
<td>0.50</td>
<td>0.32</td>
<td>2.26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>10</td>
<td>1.09</td>
<td>0.58</td>
<td>0.25</td>
<td>1.79</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>10</td>
<td>1.42</td>
<td>0.72</td>
<td>0.63</td>
<td>2.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>10</td>
<td>2.55</td>
<td>1.56</td>
<td>0.91</td>
<td>6.18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>50</td>
<td>1.33</td>
<td>1.05</td>
<td>0.25</td>
<td>6.18</td>
<td></td>
</tr>
<tr>
<td>Pasty</td>
<td>I</td>
<td>10</td>
<td>3.06</td>
<td>1.06</td>
<td>1.44</td>
<td>4.54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>10</td>
<td>2.19</td>
<td>1.18</td>
<td>0.70</td>
<td>4.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>10</td>
<td>2.88</td>
<td>2.25</td>
<td>0.80</td>
<td>7.09</td>
<td>0.070</td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>10</td>
<td>2.93</td>
<td>1.34</td>
<td>1.01</td>
<td>5.19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>10</td>
<td>5.59</td>
<td>3.19</td>
<td>1.05</td>
<td>10.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>50</td>
<td>3.33</td>
<td>2.23</td>
<td>0.70</td>
<td>10.91</td>
<td></td>
</tr>
</tbody>
</table>

Note: The mean shown in the table is the sum of the oral transit times of all patients that level motor divided by the total number of patients in the same level. Jonckheere-Terpstra test (p<0.001 for liquid and p=0.070 for pasty)

Table 2. Oral transit time, in seconds, of children with cerebral palsy, in the liquid consistencies, according to impairment of swallowing

<table>
<thead>
<tr>
<th>Time</th>
<th>Swallow</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>31</td>
<td>0.87</td>
<td>0.47</td>
<td>0.25</td>
<td>2.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild dysphagia</td>
<td>6</td>
<td>1.40</td>
<td>0.62</td>
<td>0.82</td>
<td>2.47</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Moderate dysphagia</td>
<td>7</td>
<td>2.14</td>
<td>0.89</td>
<td>0.91</td>
<td>3.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe dysphagia</td>
<td>6</td>
<td>2.69</td>
<td>1.92</td>
<td>1.06</td>
<td>6.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>1.33</td>
<td>1.05</td>
<td>0.25</td>
<td>6.18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Jonckheere-Terpstra test (p<0.001)

Table 3. Oral transit time, in seconds, of children with cerebral palsy, in the pasty consistencies, according to impairment of swallowing

<table>
<thead>
<tr>
<th>Time</th>
<th>Swallow</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>31</td>
<td>2.32</td>
<td>1.09</td>
<td>0.70</td>
<td>4.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild dysphagia</td>
<td>9</td>
<td>3.41</td>
<td>1.75</td>
<td>1.05</td>
<td>7.09</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Moderate dysphagia</td>
<td>10</td>
<td>6.39</td>
<td>2.55</td>
<td>3.40</td>
<td>10.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe dysphagia</td>
<td>50</td>
<td>3.33</td>
<td>2.23</td>
<td>0.70</td>
<td>10.91</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Jonckheere-Terpstra test (p<0.001)

groups, with a gradual increase time as increasing severity of swallowing impairment (Tables 2 and 3)

DISCUSSION

Children with neurodevelopmental disorders, such as the CP, spina bifida, or inborn errors of metabolism, often have associated gastrointestinal disorders, such as oromotor dysfunctions that lead to feeding difficulties, risk of aspiration and prolonged meal time and malnutrition

The oral transit time is an important indicator of the severity of impaired swallowing function in children with neuromotor disorders, as it can represent one of the major aspects which lead to malnutrition. In children with moderate and severe impairment CP feeding disorders are common problems associated with poor nutritional status and health. Even children with mild eating disorders, which require mashed food, may be at risk of malnutrition

Therefore, can identify clinically during clinical assessment of swallowing, how much time elapsed swallowing
Time for swallowing in cerebral palsy

As noted, the disorders that affect the oropharyngeal phase occurs mainly in children with severe motor disorders – quadriplegia. Literature study also verifies that dysphagia is strongly related to global motor functions in children with CP and the impairments in swallowing function are often found in more severe motor disorders\(^{(18)}\).

Research of the literature\(^{(19)}\) noted that there was a gradual relationship between dysphagia and GMFCS levels, increasing the probability of occurrence children in level V, compared with children of level I.

Children with severe CP with severe oromotor impairments, showed significant and generalized alterations in feeding, which demonstrate some fluctuations over time, but usually shows stability. Children with CP without oral motor impairment and those who have mild to moderate impairment, also show little or no change over time and less problems when compared to children with severe impairment\(^{(20)}\). The oral motor difficulties and the alterations in feeding are related to the gross motor function\(^{(21,22)}\).

The same statistical significance was not found for the pasty consistency, which does not reflect what was observed clinically. Analyzing the data, it was found that the significance has not occurred due to swallowing time found in the group of children motor level I, which showed close to group IV motor level. In the other groups (II to V) observed a progressive increase as higher motor level. According to the data, the ten children with motor level I, nine had normal swallowing and one mild oropharyngeal dysphagia. It is believed that the increased in time swallowing of these children does not come from oral motor deficits, but rather due to the reduction of attention during the offer and longer duration of oral manipulation performed, seeking more time to taste the food, since during evaluation revealed that the children remained with the food in the oral cavity without manipulating it voluntarily.

By dividing the children in accordance with swallowing impairment, difference was found between groups for both the liquid consistency as to pasty, with higher values of time for cases of more impairment in swallowing. In this study, there were no children with severe oropharyngeal dysphagia for pasty consistency, possibly by exclusion criteria in not being able to make use of tube feeding. Study involving children with neuromotor disorders\(^{(23)}\) found that the more severe impairment in the oral motor function, had the longer time spent to swallow in each of the three food consistencies offered, and children with oral-motor function severely impaired led 14.2 more time to swallow liquids and 6.4 more time to swallow paste food than normal children. Oral motor dysfunctions are more observed in children classified as levels IV and V of the GMFCS\(^{(18)}\).
Comparing the values of oral transit time for liquid and paste of children with normal swallowing according to the clinical evaluation of this research, with the data of normal children of age group around the study cited above\(^{10}\), there are similarity to the time data for swallowing the liquid. Thus, it is found that children with CP and lower levels motors, according to the GMFCS may present normal swallowing. The same result was not observed for the pasty consistency, due to voluntary behavior to keep the food in the oral cavity without manipulating it, seen among the children of the motor level I, as already explained. However, despite the similarity of the results with normality, it is recommended conducting clinical evaluation in children of lower levels of GMFCS motors, since two children, one motor level I and one level II had mild dysphagia. Dysphagia is present at all levels of the GMFCS, demonstrating the need to undertake early assessments and screenings in children with CP, promoting nutritional gains and respiratory stability\(^ {19}\).

**CONCLUSION**

The oral transit time in children with cerebral palsy was found increased to the food consistency offered, and may represent the severity of dysphagia presented, since that time was was longer as worse the impairment in swallowing function, and patients who took the longest were classified as having severe dysphagia. As the higher global motor impairment presented, that is, the higher the classification level of the GMFCS, the longer oral transit time presented.

**REFERENCES**
