

Paula Cristina Cola¹ Débora Afonso² Cleber Gustavo Rotoli Baldelin¹ Claudio José Rubira¹ Francisco de Agostinho Junior¹ Roberta Gonçalves da Silva² Oral transit time in children with
neurological impairment indicated for
gastrostomy*Tempo de trânsito oral na criança com
acometimento neurológico indicada à
gastrostomia*

Keywords

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Descritores

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ABSTRACT

Purpose: The objective of the present study was to describe the total oral transit time (TOTT) of children with neurological impairment (CNI) and with an indication of gastrostomy. **Method:** A cross-sectional clinical study was conducted on 15 children (10 male and 5 female ranging in age from 1 to 14 years; mean 5.7 years) with CNI and gastrostomy indication. The patients were monitored by a Multidisciplinary Group of Pediatric Gastroenterology of Universidade de Marília – UNIMAR, which 13 of them with previous exclusive oral feeding and 2 fed by a nasogastric tube. Swallowing was analyzed by videofluoroscopy swallowing study and 19 images of TOTT were obtained using specific software, with analysis of pureed food (13 images) and liquid (six images). TOTT was categorized as short or long based on definitions already evidenced in the literature. **Results:** The mean and standard deviation of TOTT values was 10.75 s and 11.76 s for pureed food and 4.22 s and 1.54 s for liquid food. **Conclusion:** The total oral transit time of pureed or liquid consistency was long in children with neurological involvement and with an indication of gastrostomy.

RESUMO

Objetivo: O objetivo deste estudo foi descrever o tempo trânsito oral total (TTOT) da deglutição em diferentes consistências de alimento na criança com acometimento neurológico (CAN) e com indicação de gastrostomia. **Método:** Estudo clínico transversal incluiu 15 indivíduos com CAN e indicação de gastrostomia, sendo 10 do sexo masculino e cinco do sexo feminino, 13 com alimentação via oral exclusiva e dois com sonda nasogástrica, faixa etária de um a 14 anos, média de 5,7 anos, acompanhados no Grupo Multidisciplinar de Gastroenterologia Pediátrica da Universidade de Marília-UNIMAR. A deglutição foi analisada por estudo videofluoroscópico da deglutição. Foram mensuradas 19 imagens do tempo de trânsito oral total (TTOT) da deglutição, por software específico, utilizando alimento pastoso (13 imagens) e alimento líquido (seis imagens). O TTOT foi categorizado em curto ou longo baseado em definições já evidenciadas na literatura. **Resultados:** A média e o desvio padrão para o TTOT foram, respectivamente, 10,75s e 11,76s para o pastoso e 4,22s e 1,54s para o líquido. **Conclusão:** O tempo de trânsito oral total é longo nas consistências pastosa e líquida em crianças com acometimento neurológico e com indicação de gastrostomia.

Correspondence address:

Paula Cristina Cola
Avenida Higyno Muzzy Filho, 1001,
Campus Universitário, Marília (SP),
Brasil, CEP: 17525-902.
E-mail: paccola@hotmail.com

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Study conducted at Laboratório de Disfagia, Departamento de Fonoaudiologia, Faculdade de Filosofia e Ciências, Universidade Estadual Paulista – UNESP - Marília (SP), Brasil.

¹ Departamento de Medicina, Universidade de Marília – UNIMAR - Marília (SP), Brasil.² Departamento de Fonoaudiologia, Universidade Estadual Paulista – UNESP - Marília (SP), Brasil.**Financial support:** nothing to declare.**Conflict of interests:** nothing to declare.

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INTRODUCTION

Children with cerebral palsy (CP) may have neurological disorders involving motor development frequently accompanied by sensation, cognition, communication and perception deficits and convulsions⁽¹⁾. Although this terminology is extensively used to specifically define this population, the diagnosis involves a lot of generalization and this group of children becomes quite heterogeneous since some of them may have genetic involvement⁽²⁾.

Among the symptoms of children with neurological impairment (CNI), oropharyngeal dysphagia has a prevalence ranging from 43 to 99%, affecting different phases of swallowing according to disease classification and degree of neurological and/or motor impairment⁽³⁻⁵⁾, with nutritional and hydration losses, pulmonary complications and loss of eating pleasure. The neurological impairment of this population affects the neuromotor control of swallowing and may cause varying degrees of impairment of the oral, pharyngeal and esophageal phases of swallowing. There is a severity impaired in oral phase of swallowing, with various disorders of oral control that range from lip sealing, which impairs the control of food inside the oral cavity, to oral incoordination that may prolong the oral and pharyngeal transit time of food. Thus, oropharyngeal impairment may result in inefficient and poorly safe swallowing regarding the pulmonary condition.

Temporal quantitative analysis of the swallowing phases is carried out by videofluoroscopy of swallowing and with the use of specific and distinct types of software, more frequently in the adult population, whether healthy or having suffered a cerebrovascular accident (CVA)⁽⁶⁻¹²⁾. In addition to concerning the adult population, most of these studies have described the time and parameters related to the pharyngeal phase of swallowing⁽¹³⁾, while few have focused on the oral phase of swallowing^(12,14). The few studies available for the pediatric population have reported temporal qualitative and quantitative measures of the pharyngeal and oral phases in children with normal deglutition and in children with oropharyngeal dysphagia⁽¹⁵⁻¹⁹⁾. A quantitative study of swallowing is relevant because of the scarce evidence about the relationship between these parameters and swallowing transit time and because of its possible contribution to the identification of risk markers for aspiration and/or malnutrition that may help the definition of conducts and facilitate the control of therapeutic efficacy in the dysphagic population under study⁽²⁰⁾.

Another relevant question within the context of the measurement of oropharyngeal time for CNI is the time needed for oral feeding in children with neurological disorders, which might compromise the nutritional condition. On average, 3.5 hours per day are needed to feed these children, as opposed to 0.8 hours for children without neurological impairment. And the prolonged feeding time may not effectively guarantee the necessary nutritional supply, frequently leading these children to malnutrition^(21,22).

Thus, considering the impact of neurological impairment on the oral phase of swallowing and how much this aspect may compromise the total feeding time for these children, it is necessary to understand the performance of this parameter in

order to obtain information that will contribute to the evaluation of clinical aspects in this population. This, in turn, together with the nutritional and pulmonary condition, may contribute to clinical make decision and the definition of the use of an alternative feeding such as gastrostomy that would not depend on the safety of swallowing⁽²³⁾.

OBJECTIVE

The objective of the present study was to describe the total oral transit time of swallowing food of different consistencies for CNI with an indication of gastrostomy.

METHOD

The study was approved by the Research Ethics Committee on Human Beings of the Educational Institution (protocol no, 1.905.697).

The authors analyzed swallowing videofluoroscopy exams captured with 30 frames of CNI with an indication for percutaneous or surgical endoscopic gastrostomy by interdisciplinary team. Excluded were images that did not permit temporal analysis of the oral phase of swallowing due to technical questions during the execution of the exam or that did not permit correct image capture due to inappropriate body movement by the subjects, resulting in the inclusion of a total of 19 images of these exams. These images were from 15 individuals, 10 male and 5 female aged one to 14 years, with Gross Motor Function Classification Scale (GMFCS) ranging from I to V (Chart 1) who were submitted to the exam during the process for the diagnosis of oropharyngeal dysphagia by the Multidisciplinary Team of the Pediatric Gastroenterology Clinic of the University of Marília (UNIMAR). After the conclusion of a diagnosis of oropharyngeal dysphagia and a discussion with the multidisciplinary group, the team, using criteria related to the presence of oropharyngeal dysphagia and impairment of nutritional and pulmonary conditions, indicated gastrostomy for all the subjects under study. Thirteen of these patients were before indication exclusively oral feeding and two were nasogastric tube feeding.

Protocol for videofluoroscopic assessment of swallowing

Swallowing videofluoroscopy exams were performed at Unimagem, Hospital Beneficente Unimar (Unimar Charity Hospital) affiliated with the Pediatric Gastroenterology Clinic. The procedure was conducted using a protocol based on the methods of Logemann⁽⁶⁾ and Martin-Harris et al.⁽²⁴⁾ recommending, when possible, that the assessment should be started with the offer of pureed food. The tests were carried out by a single examiner with more than 10 years of training in oropharyngeal dysphagia and objective exams of swallowing.

A Toshiba seriograph, model KXO-15E and a Toshiba table with inclination of up to 180° were used for the procedure. The images were transmitted on the monitor and recorded on a DVD using a DVD player with 30 frames for later quantitative analysis using specific software⁽²⁵⁾.

Chart 1. Patients' characterization

Subject	Sex	Age	Etiology	GMFCS
1	Female	5 years and 11 months	NCPE	Level V
2	Male	7 years and 8 months	NCPE	Level V
3	Male	7 years and 4 months	NCPE	Level V
4	Male	2 years	NCPE	Level V
5	Male	9 years and 7 months	NCPE	Level V
6	Female	6 years and 8 months	NCPE	Level V
7	Male	8 years and 4 months	NCPE	Level V
8	Female	7 years and 9 months	West Syndrome	Level V
9	Male	1 year and 4 months	Congenital Toxoplasmosis	Level V
10	Female	6 years and 11 months	Microcephaly	Level V
11	Male	2 years and 9 months	NCPE	Level V
12	Female	14 years and 2 months	NCPE	Level I
13	Male	10 years and 5 months	NCPE	Level V
14	Male	1 year and 6 months	NCPE	Level IV
15	Male	1 year and 2 months	NCPE	Level V

Caption: NCPE = Non-progressive chronic encephalopathy

Preparation and offer of the food consistencies

For the execution of the exam, the child was positioned sitting in an adapted chair or on the lap of the accompanying person at the same inclination as that provided by the chair. Food of fine pureed or liquid consistency was prepared. Barium sulfate (BaSO₄) was added to both preparations at the proportion of 50% barium to 50% food without changing the consistencies previously standardized. The fine pureed food was offered on a spoon in a 5 ml volume when indicated. The liquid food was always offered in the bottle normally used by the patients since this was the utensil they were already using.

Temporal quantitative analysis of Total Oral Transit Time (TOTT)

For quantitative analysis of TOTT we used the software proposed by Spadotto et al.⁽²⁵⁾ which provides a time registration in milliseconds by means of the analysis of video frames and swallowing serialization. In the present study, TOTT was defined as the interval in milliseconds between the first image showing the food inside the oral cavity and the first frame showing the proximal part of the food bolus in the final region of the hard palate and the beginning of the soft palate, not exceeding the lower ramus of the mandible, as proposed by Logemann et al.⁽⁹⁾ and adapted by Gatto et al.⁽²⁶⁾. In order to define TOTT as long or short we used as a base the only values for the normal pattern of TOTT detected in the literature⁽¹⁵⁻²⁷⁾.

Statistical analysis

The quantitative temporal analysis of TOTT was performed by two raters and the intraclass correlation coefficient (ICC) was used to determine inter-rater reliability, which was found to be excellent, with 1.0 ICC for both the pureed and liquid consistencies (95% ICC: 1-1). The mean and standard deviation of TOTT was then calculated for the subjects according to food

consistency. Descriptive analysis was based on the mean and standard deviation of TOTT as the quantitative variable. Data were analyzed statistically using the Statistical Package for the Social Sciences (SPSS) software for Windows, version 23.0 (IBM, Chicago, IL, EUA).

RESULTS

Table 1 showed media and standard deviation (SD) of the TOTT in pure and liquid consistencies in children with neurological impairments indicated to gastrostomy.

We found in Table 1 that the media and SD of TOTT was longer than in results found in the literature in children without gastrostomy.

Table 1. Mean and standard deviation of TOTT values for pureed and liquid food offered to children with Cerebral Palsy and with an indication of gastrostomy

Subjects	TOTT of Pureed food	TOTT of liquid food
1	6.406	-
2	13.98	-
3	11.78	-
4	15.849	4.404
5	2.102	-
6	4.270	1.201
7	8.808	-
8	34.701	-
9	2.068	5.238
10	0.667	-
11	2.535	4.838
12	1.901	-
13	35	-
14	-	4.237
15	-	5.405
Mean	8.739	4.221
SD	9.651	1.547

Caption: TOTT = Total Oral Transit Time; SD = Standard deviation

DISCUSSION

Oral transit time (OTT) is one of the parameters less studied in the quantitative analysis in patients with dysphagia due to the multiple variables involved in its definition⁽¹³⁻²⁸⁾. In addition, only two normative studies on OTT are available in the literature for the pediatric population, while no normative studies on TOTT are available for the same population. However, the investigation of transit time during the oral phase is justified due to its possible impact on questions regarding the efficiency and safety of swallowing in these specific dysphagic populations.

In the present study, the measurements of TOTT detected in CNI and the indication of gastrostomy, presented in Table 1, revealed longer mean times for both the pureed and liquid food consistencies than those reported in the literature for normal children and children with genetic syndromes classified as involving normal TOTT^(15,17,27). Duca et al.⁽²⁷⁾ studied OTT in children with gastroesophageal reflux and detected a mean OTT value of 0.23 s (230 ms) for the pureed consistency and of 0.15 (150 ms) for the liquid consistency. In another study conducted on children with different genetic syndromes, the time for the group classified as having normal TOTT was 1.12 s (1.120 ms) for the pureed consistency and 0.75 (750 ms) for the liquid consistency. The longer time for the pureed consistency was also detected for the group with altered TOTT, i.e., 9.54 s (9.540 ms), with a value of 5.42 s (542 ms) for the liquid consistency⁽¹⁷⁾.

Thus, the great difference in mean TOTT detected between consistencies in CNI was expected and was reported in other studies, since the viscosity of pureed food is different from that of liquid food⁽¹⁷⁻²⁹⁾. However, this marked increase in TOTT for pureed food in CNI, a mean value of 8.739 ms compared to a value of 0.23 s (230 ms) in the literature, involves more than the viscosity of the food. The pureed consistency also requires greater activity of the oral coordination for an efficient propulsion of the food bolus⁽³⁰⁾ and in the population with cerebral palsy (CP) the necessary muscle activity and oral coordination is affected by the severe motor impairment of this condition. This also depends on the subtype of CP, whose oral phase is characterized by the absence of lip sealing for food capture, premature anterior food spillage, and lack of coordination of tongue movements and oral reflexes⁽⁵⁾.

The challenge in the present study, which also indicates its limitations, was the fact that the correlation between this study and others is because of the parameters and method used to analyze the OTT parameter are cited with different definitions in the literature, with more frequent reports about adult populations^(9,11,12). In addition, in some reports OTT was measured using both a software and some other means such as a chronometer or a timer coupled to the video monitor, with some of them specifically studying the pediatric population^(15,17-19).

The difficulties in the execution of a temporal quantitative analysis in CNI also contribute to the reduced number of studies with this population. The inadequate postural positioning impairs a good capture of the image, causing a loss of anatomical and function markers during the execution of the exam for later analysis. Furthermore, the use of different utensils normally diversified for the adaptation of feeding in CNI compromises

the comparison of the few studies conducted on this population, since not all of them used the same utensil.

Another point to be emphasized is the variability of the values obtained in the present study even when the same food consistency was compared, causing an increase in the standard deviation for the study population. These findings suggest the need for studies on more homogeneous populations, especially regarding subtype, level of gross motor function and age range, so that more robust conclusions may help define conducts regarding gastrostomy. On the other hand, regardless of sample heterogeneity, all subjects had an increased TOTT and this aspect should be discussed within the context of eligibility criteria for the definition of gastrostomy, since it could compromise the quantity of orally ingested food.

CONCLUSION

TOTT of food of pureed or liquid consistency was longer in patients with CNI and an indication of gastrostomy.

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Authors contributions

We declare that all authors participated sufficiently in the study in order to render public their responsibility about its content and that there were no conflicts of interest among them regarding the authorization of its reproduction. PCC senior investigator, elaboration of the research; DA data collection and analysis and paper writing; RGS and FAJ advisers, elaboration of the research and paper writing; CGRB and CJR statistical design and help with paper writing.