What consistency of food is best for children with cerebral palsy who cannot chew?

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Abstract
Video recordings were made of 67 children with cerebral palsy and 64 able bodied children eating soft boiled ('non-mashed') and mashed potato. Those children with cerebral palsy who had no speech, presumed to have poor oral motor function, took significantly longer to eat non-mashed than mashed potato. Children with cerebral palsy, especially those with no speech, were more likely to cough or choke while eating non-mashed than mashed potato.
It is recommended that children with cerebral palsy who have poor oral motor function are offered food that they can eat with the least frustration or distress. This may also improve their dietary intake and state of nutrition.

Children with cerebral palsy often have difficulty eating.¹ They can take up to 18 times longer to eat a mouthful than normal children.² It is not surprising that many such children are emaciated.
It is not known what is the best type of food to offer children with cerebral palsy who have eating difficulty. They may be less likely to aspirate solid food.³ Children with cerebral palsy, however, as well as normal children, take longer to eat solid than puréed food.²
It has been recommended that children with cerebral palsy should be weaned from purée to solid food.⁴ It is not known whether or not this promotes the development of oral motor function.
It was the hypothesis of this study that children with cerebral palsy who had poor oral motor function, unlike normal children, would take significantly longer to eat soft solid food, than the same food after it had been mashed.

Subjects and methods
Seventy one children with cerebral palsy, as defined by Robinson *et al*,¹ were identified at two special schools. Four children were unavailable or unwilling to participate. The school speech therapists independently divided the

children into three groups according to their ability to speak (table 1): those with normal or near normal speech (group I), those with poor speech (group II), and those with no speech (group III). Sixty four normal children were recruited from local mainstream schools for comparison (table 2).
Video recordings were made of all the children eating potato in their school dining area just before a main meal. The video camera was positioned about four metres from the children, who were thus aware of being recorded, but unaware of the purpose. Each child was given 10 g (1–2 teaspoons) of soft boiled potato ('non-mashed') and 10 g of this potato after it had been mashed. The potato had been cooked in lightly salted water but no butter or milk was added. The only difference therefore between the mashed and non-mashed potato was the texture. The potato was weighed on electric scales that were accurate to ± 0.5 g. Random numbers were used to determine the order in which each child was served the two types of potato.⁵ Children with cerebral palsy who could not feed themselves independently were assisted or fed by care givers familiar to them who used their knowledge of the children to determine the size of each spoonful offered. Every effort was made to avoid loss of spilled food.
The time taken by each child to eat 10 g of mashed and 10 g of non-mashed potato ('eating time') was measured by stopwatch from the video recording. The eating time was defined as the time from the beginning of the first mouthful until the 10 g of potato had been swallowed. Children with relatively good oral motor function were able to demonstrate that they had swallowed the potato. In the case of the more dependent children, the care givers feeding them were asked to indicate when the potato had been swallowed.
The eating times of children with cerebral palsy were measured twice by the author, at an interval of six weeks. The standard deviation of the differences between these pairs of eating times was taken to be a measure of intraobserver reliability. An independent colleague timed 10

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Table 1 Numbers of children in each group with each main type of cerebral palsy

Type of cerebral palsy	Group I	Group II	Group III	Total
Hemiplegia/diplegia	14	1	0	15
Athetoid	2	3	5	10
Spastic quadriplegia±athetoid	7	10	25	42
Total	23	14	30	67

Table 2 Numbers of children with cerebral palsy in each group, and normal children, in each age range

Age range (years)	Children with cerebral palsy			Normal children
	Group I	Group II	Group III	
3–6	6	5	3	23
7–11	9	6	11	23
12–18	8	3	16	18
Total	23	14	30	64

randomly chosen children with cerebral palsy to provide a measure of interobserver reliability by a similar calculation.

The eating times for mashed and non-mashed potato were compared by the Wilcoxon signed rank test. This comparison was made separately for each group of children with cerebral palsy and for the normal group.

Children with cerebral palsy in group III (those with no speech) were compared with age and sex matched controls. The children with cerebral palsy were matched with the first suitable controls in order of recruitment. Age matching was to within a year for children aged 10 years or less, and to within two years for children aged over 10 years. The number of children with cerebral palsy in group III who took one and two minutes longer to eat non-mashed potato than mashed potato, and vice versa, was compared with the number of normal control children who did so. The χ^2 test was used to assess the significance of this difference.

Any coughing or spluttering seen on the video recording was noted. The number of children with cerebral palsy who coughed or spluttered while eating non-mashed potato was compared with the number who did so while eating mashed potato. The number of children with cerebral palsy in group III (those with no speech) who coughed and spluttered was compared to the number of children in groups I and II (those with speech) who coughed or spluttered. The χ^2 test was used to assess the significance of these differences.

Results

The standard deviation of the differences between the pairs of eating times of children with cerebral palsy, or intraobserver reliability, was 6.0 seconds. The standard deviation of the differences between the eating times of 10 randomly chosen children measured by the author, and the eating times of the same children measured by an independent observer, or interobserver reliability, was 11.7 seconds. Thus the maximum experimental error was taken to be ± 11.7 seconds.

The children with cerebral palsy who had no speech (group III) had significantly longer eating times for non-mashed potato than for mashed potato ($p < 0.01$). Their eating times for non-mashed potato were on average nearly a minute longer than for mashed potato (table 3), well in excess of the maximum experimental error of ± 11.7 seconds. In group III a significant number of children took two minutes longer to eat non-mashed than mashed potato (table 4).

Neither children with cerebral palsy who had speech (groups I and II) nor normal children

Table 4 Number of children who took one or two minutes longer to eat 10 g of non-mashed than 10 g of mashed potato and vice versa

	Group III	Normal children
Total No of children	30	30
No who took 1 minute longer to eat non-mashed potato	12*	0
No who took 1 minute longer to eat mashed potato	2	0
No who took 2 minutes or longer to eat non-mashed potato	5**	0
No who took 2 minutes longer to eat each mashed potato	1	0

By χ^2 * $p < 0.001$ and ** $p < 0.01$.

had significantly longer eating times for non-mashed than for mashed potato.

Nine children with cerebral palsy coughed or spluttered while eating non-mashed potato, sometimes experiencing distress. Only two children with cerebral palsy coughed or spluttered while eating mashed potato; this difference is significant ($p < 0.05$). All the children who coughed or spluttered, except one, were in group III, a significant finding ($p < 0.01$). No normal child coughed or spluttered.

Discussion

Children with cerebral palsy who had no speech, presumed to have worse oral motor function as a group than those with speech, took significantly longer to eat soft solid food than mashed food. This difference in texture was too slight to affect either normal children or children with cerebral palsy who had speech.

Children with cerebral palsy are often malnourished. A likely cause is poor food intake, although exact measurement of food intake in children who spill and waste much of their food is difficult. There is evidence that children with poor oral motor skills are especially likely to be underweight.⁶ We have also found that non-speakers were thinner and lighter than speakers (R D Croft, R O Robinson, M A Cockram, unpublished observations). This present study showed that non-speakers took on average six times longer to eat 10 g of soft boiled potato than normal children. This was almost a minute longer on average than it took them to eat mashed potato. It is likely therefore that the choice of food texture could significantly affect the dietary intake of children with poor oral skills, and as a result, their nutritional state.

Many of the severely affected children with cerebral palsy at Chailey Heritage Hospital have respiratory problems associated with eating or drinking. These children are mainly non-speakers. Some have reflux with aspiration and others have abnormalities of swallowing. Significantly more children in this study coughed or spluttered while eating non-mashed potato. On two occasions this coughing lasted several minutes and in one case the child became cyanosed and the study was discontinued. We have no prospective data on the serious long term complications of aspiration. The finding of this study is that children who cannot chew have more problems with lumps of food than

Table 3 Mean times, in seconds, taken by children to eat 10 g of mashed and 10 g of non-mashed potato

	Children with cerebral palsy			Normal children
	Group I	Group II	Group III	
Mashed	38	92	134	29
Non-mashed	40	108	192	31

mashed food and they sometimes experience distress that may be severe.

Younger children at Chailey Heritage Hospital with poor oral motor function receive oral motor therapy in groups, four times a week, as part of a conductive education programme. The oral motor therapy occupies about 10 minutes of each session. Older children, from about the age of 11, receive individual therapy as appropriate. Attention is paid to maintaining good seating and head position and practising lip closure, jaw control, breathing, swallowing, and tongue movements. Our impression is that this oral motor therapy is effective because we observe improvement in the speaking and eating skills, and a reduction in drooling, in new pupils who have been admitted to the hospital. There is however little research based evidence to confirm this. This study shows that there is a limit to what should be expected from oral motor therapy. Despite regular therapy as described above, many children with poor oral motor function will continue to be unable to chew. The practice at Chailey Heritage Hospital has therefore been modified. The most malnourished children with poor oral motor function are now given mainly

mashed food, which can be mixed with gravy or sauces, which in turn could be fortified with protein-energy rich powders. The nutritional benefits are being evaluated.

Some individuals with cerebral palsy, in our experience at this hospital, continue to develop skills, such as improvements in speech, in their teens and even their late teens. For this reason, we do not recommend any specific age at which oral motor therapy should be abandoned. Practice with food of more difficult textures can form part of this therapy. The main meal, for those who cannot chew, should be mashed food.

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- 5 Bradford Hill A. Random number sampling. *A short textbook of medical statistics*. London: Hodder and Stoughton, 1984:286-96.
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