Use of Substitute Food Textures for Standard Eating Assessment in Children With Cerebral Palsy and Children Without Disabilities

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Key Words: eating and feeding evaluation • oral motor assessment

Objective. Eating assessment is the first step toward amelioration of eating problems in children. A quantitative evaluation tool with three standard textures of food has been developed to determine the severity of an eating problem. However, children occasionally refuse some of the standard textures. Much time and effort could be saved if substitute textures could be used for testing. The purpose of this study was to examine the feasibility of using substitute food textures.

Method. Twenty children (10 without disabilities, 10 with cerebral palsy and eating impairments) with a mean age of 8.2 years (SD = 4.1) years were tested with three standard and three substitute textures of food (solid, viscous, puree). Eating time (in seconds) and chewing cycles were compared between standard and substitute textures as well as between children without disabilities and children with eating impairments.

Results. Substitutes for pureed and viscous, but not solid textures could be used for children without disabilities; in children with eating impairments, substitutes for viscous and solid, but not pureed textures could be used.

Conclusion. Children with eating impairments may be more sensitive than children without disabilities to small changes in food consistencies or other characteristics of the food. Thus, in standardized testing, food textures should not be arbitrarily interchanged.

Eating difficulties are common in children with neuromotor dysfunctions (Bax, 1989; Denhoff, 1981; Gisel, 1993, in press), those who are failing to thrive (Mathisen, Skuse, Wolke, & Reilly, 1989; Ramsay, Gisel, & Boutry, 1993), and those with severe emotional disturbances and mental retardation (Riordan, Iwata, Finney, Wohl, & Stanley, 1984; Riordan, Iwata, Wohl, & Finney, 1980; Stroh, Robinson, & Stroh, 1986). Severe eating difficulties may lead to inadequate nutrient intake and malnutrition, which is known to affect brain size and central nervous system function (Galler, Ramsey, & Solimano, 1984; Galler, Ramsey, & Solimano, 1985; Galler, Ramsey, Solimano, Kucharski, & Harrison, 1984), impair cognitive and psychomotor development (Reilly & Skuse, 1992), and retard growth (Ottenbacher, Scoggins, & Wayland, 1981; Stallings, Charney, Davies, & Cronk, 1993; Sterling, 1960; Thomessen, Kasc, Ris, & Heiberg, 1991; Tobis, Saturen, Larios, & Posniak, 1961). Bax (1989) found that among 100 young persons with severe disabilities, 40% had major feeding problems. Patrick, Boland, Stoski, and Murray (1986) noted that malnutrition has been almost accepted in the past as part of the disability.

In the developing human, ingestion proceeds from suckling to mature feeding, which requires the graduation from an exclusively liquid diet to physically varied...
foods (Bosma, 1992; Stevenson & Allaire, 1991). The complex oral skills needed to deal with different food textures (liquid, puree, viscous, solid) are acquired by children over a number of years (Gibbs et al., 1982; Gisel, 1988, 1991). With the introduction of solid foods during weaning, the rhythmic anteroposterior movements of tongue and jaw give way to mastication, up-and-down movements of the mouth and jaw give way to munching, up-and-down movements of the tongue and jaw give way to the rhythmic anteroposterior movements of the tongue and jaw (Gisel, 1991). Ingestion of liquids through sucking is distinct from sucking in that it requires the stimulation of the jaw in a semiopen position (Gisel, in press), the drawing up of liquid with the lips from an open container, and the simultaneous coordination of respiration and swallowing (McPherson et al., 1992).

Eating impairments are characterized by the arrest or delayed maturation of oral motor skills in earlier stages of development. Primitive reflexes such as the biting and sucking reflex may persist (Campbell, 1979) or tongue lateralization and lip control for drinking may never develop (Gisel, in press). Immature oral motor patterns may prevent a child from ingesting age-appropriate food textures. Thus, ingestion of a regular table diet requires a mature set of oral motor skills to cope with the demands of different textures of food. Eating impairments may further be aggravated by a developmentally inadequate diet, creating an increasing discrepancy between the child's growing energy needs and actual nutritional intake (Patrick & Gisel, 1990; Reilly & Skuse, 1992). Because liquid and pureed substances generally have a lower caloric density than solid foods (Walker, 1990), children with oral motor problems will have to spend progressively more time eating to ascertain an adequate energy intake. Thus, energy demands may eventually exceed the available time for feeding, and malnutrition will result. Because of the extensive efforts and time spent feeding children with eating impairments, it is not surprising that caregivers perceive meal times as frustrating and exhausting (Reilly & Skuse, 1992; Thomessen et al., 1991). Therefore, the first step toward the amelioration of eating problems is comprehensive assessment, which must consider the severity of the problem as well as the child's oral motor capacity and nutritional needs.

Recent work has indicated that children's responses to different food textures during quantitative evaluation permits the separation of children with potential for oral motor therapy from those who lack skills for adequate oral ingestion (Gisel & Patrick, 1988). Evaluation is based on the oral motor development of healthy children and the diagnosis of mild, moderate, or severe eating difficulty is made by comparison with established norms (Alphonce-Schweizer & Gisel, 1994). Normative data exist for children from 6 months to 8 years of age using differently textured foods (puree, viscous, and solid) (Gisel, 1988, 1991). Whereas a child with severe eating impairments will have difficulty eating pureed and solid food textures within two standard deviations of the time norms, a child with moderate eating impairments is able to eat a solid food texture at or below one standard deviation and a pureed texture at or below two standard deviations of established time norms (Alphonce-Schweizer & Gisel, 1994; Gisel & Patrick, 1988).

A problem encountered in testing children with eating impairments is that they will occasionally refuse to eat our standard textures, not because they are unable to ingest them, but because of idiosyncratic taste preferences. To allow testing to proceed, it would be useful to have specific alternative foods available for such children. However, the arbitrary change to similar food textures during testing might alter the significance of the results (Gisel, 1991). It is unknown whether substitutes for the standardized textures would be eaten within the same time limits as the standardized textures, or whether children with and without eating impairments respond to substitute textures in the same manner. Therefore, the purpose of the present study was to determine the feasibility of using substitute food textures while maintaining the validity of the diagnostic tool.

Method

Subjects

Twenty children, 10 without disabilities and 10 with cerebral palsy and eating impairments, participated in the study. Subjects’ ages ranged from 5.8 to 15.5 years. The 10 children without disabilities (7 girls and 3 boys) attended a special school in Montreal that integrates children without disabilities and children with motor and cognitive impairments. Their mean age was 8.1 years (SD = 1.8). They had no neuromotor impairments, were ambulatory, could feed themselves, and could understand and follow verbal instructions. The 10 children with cerebral palsy (5 girls and 5 boys) had motor impairments ranging from mild to moderate. They attended one of two special schools in Montreal. Their mean age was 10.7 years (SD = 3.1). Five of these children (2 boys and 3 girls) had moderate eating impairments and had a mean age of 8.4 (SD = 1.5) years. They used wheelchairs for ambulation; needed assistance with activities of daily living, including eating; and manifested a range of hypotonicity to hypertonicity in their trunk and all extremities. The severity of spasticity varied between upper and lower extremities or between the right and left body sides. The other five children (3 boys and 2 girls) had mild eating impairments and a mean age of 13.1 (SD = 2.2) years. They had mild quadriplegia, diplegia, or hemiplegia, but were ambulatory and able to feed themselves. All children were able to voluntarily cooperate during testing. Stratification into mild and moderate eating impairment groups was based...
on earlier established criteria that considered measures of growth, eating efficiency, and eating and drinking performance (Alphonce-Schweizer & Gisel, 1994).

All children without disabilities ate the three standard food textures within the limits of the established time norms (Gisel, 1988). Children with cerebral palsy ate a solid texture within one standard deviation of the time norms but were at or below two standard deviations of the time norms for a pureed texture. Children were not persuaded to eat any food that they refused. None of the children in the study was allergic to the foods offered. We have shown earlier that gender does not influence our eating measures (Gisel, 1988). Written institutional and parental consent and verbal consent of the child were obtained before testing.

Procedures

Children were tested in their respective schools, in a quiet, well-lit room, free from distractions. The time interval between testing and the subjects’ last meal was at least 1½ hr. Ambulatory children were seated on a chair with their feet flat on the floor. The rest of the children were tested in their custom-fitted wheelchairs. Sitting position was checked and the following posture aimed for: trunk in the upright position (90° flexion at the hips or slightly inclined forward), with the head positioned in midline and in a slight chin tuck position (30° head flexion). Children with head rests were aligned with their head support systems. A lap tray was placed on the wheelchair and the arms were positioned on the lap board. Arms were flexed at 90° and feet were placed flat on the foot rests. A videocamera was placed 1.8 m from the child to obtain a semiprofile view. The feeder was sitting directly in front of the child. Before testing, the feeder introduced all children to the goal and proceedings of the testing. The feeding session started as soon as the child felt comfortable with the set-up and lasted no more than 15 to 20 min.

The same tester fed the children throughout the study. All children were told what food was going to be offered, although some subjects could not speak. The camera operator followed the children’s movements so that the semiprofile view was maintained. Children were offered 5 spoonfuls or 5 bites of each standard texture (solid, puree, viscous) followed by the new textures, in random order. This order of presentation was reversed in approximately half of the children.

Instrument

Chewing duration (in seconds) was measured between placement of food in the mouth and completion of the first swallow. A chewing cycle was defined as one down- and-up movement of the mandible. The mean from 5 bites of food (both time and cycles) was used for statistical comparisons. The interobserver reliability of our mo-

Data Analysis

Differences between standard and substitute textures were computed in each group and a Wilcoxon signed rank test was used to determine significance. Group comparisons between normal subjects and subjects with eating impairments were made for each texture with a t-test for independent samples. Eating impairment was classified as either mild or moderate (Alphonce-Schweizer & Gisel, 1994) and these two groups were compared to determine differences in time and cycles for each texture with a t-test for independent samples.

Results

The first question raised was whether food textures similar to our standard textures could be used as substitutes when children refuse our standard textures. Differences in the group without disabilities were not significant for time or cycles between the standard and substitute textures of either pureed or viscous foods (see Table 1).

However, there was a significant difference in time for the solid food (z = 2.446, p < .007). In the group with disabilities, 7 children ate the arrowroot biscuit in less time than the graham biscuit. Two children took the same amount of time to eat either biscuit, and 1 child took longer to eat the arrowroot biscuit than to eat the graham biscuit. Five children of the group without disabilities ate applesauce in a shorter time than pudding. 1 child took the same amount of time for both purees, 2 children took longer to eat applesauce than pudding, 1 child refused applesauce, and another refused pudding. All other children accepted all food textures offered.

In the group with cerebral palsy, 7 children took less time to eat the graham biscuit than the arrowroot biscuit, whereas 3 took more time. There were no significant differences in time or cycles in the viscous and solid textures, but a significant difference was found in the time measure of the puree (z = -1.784, p < .037). Seven of the 10 children took less time to eat applesauce than pudding, whereas 3 took more time.

Our second question was whether there were differences in time or cycles in the standard and substitute textures between a group of children with and a group without eating impairments and cerebral palsy. There were no significant differences between the two groups for the pureed textures, but significant differences were found for both the viscous and solid textures (see Table...
### Table 1
Substitute Textures for Standard Testing in Children With Cerebral Palsy and Normal Age Mates Without Disabilities

<table>
<thead>
<tr>
<th>Group</th>
<th>Texture Difference</th>
<th>Time</th>
<th>Cycles</th>
<th>z</th>
<th>p</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Puree Applesauce(b)–Pudding</td>
<td>-0.910</td>
<td>1.81</td>
<td>-1.260</td>
<td>.104</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Viscous Orange gelatin(b)–Strawberry gelatin</td>
<td>0.051</td>
<td>0.48</td>
<td>0.665</td>
<td>.254</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Solid Graham biscuit(b)–Arrowroot biscuit</td>
<td>2.446</td>
<td>&lt;0.007</td>
<td>0.561</td>
<td>.287</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Puree Applesauce(b)–Pudding</td>
<td>-1.784</td>
<td>&lt;0.037</td>
<td>-0.306</td>
<td>.380</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Viscous Orange gelatin(b)–Strawberry gelatin</td>
<td>-1.172</td>
<td>0.121</td>
<td>1.580</td>
<td>.057</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Solid Graham biscuit(b)–Arrowroot biscuit</td>
<td>-1.580</td>
<td>0.057</td>
<td>1.529</td>
<td>.063</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Statistics are derived from differences in time (seconds) and cycles between the standard and substitute texture. Wilcoxon signed rank test (Mann-Whitney U test). There was a difference in cycles for the orange gelatin \((t = 2.908, df = 18.0, p < .009)\). A significant difference in time was found for both solid textures: graham biscuit \((t = 2.665, df = 12.7, p < .020)\) and arrowroot biscuit \((t = 3.304, df = 10.1, p < .008)\).

The third question addressed was whether there were differences when the group of children with cerebral palsy was stratified into groups with mild and with moderate eating impairments (see Table 3). These findings must be regarded as preliminary because of the small sample size. A significant difference was found with puree (pudding) in the measure of time \((t = -2.429, df = 8.0, p < .041)\). None of the other textures reached significance.

### Table 2
Comparison of Time and Cycles of Standard and Substitute Food Textures in Children With Cerebral Palsy and Children Without Disabilities

<table>
<thead>
<tr>
<th>Texture</th>
<th>Without Disabilities ((n = 10))</th>
<th>Cerebral Palsy ((n = 10))</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>Mild ((n = 5))</th>
<th>Moderate ((n = 5))</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puree Applesauce(^a)</td>
<td>Time (sec) 2.56 (0.95) 3.28 (1.94)</td>
<td>1.051 13.4 (312)</td>
<td></td>
<td></td>
<td></td>
<td>Time (sec) 2.44 (0.90) 4.12 (2.42)</td>
<td>-1.455</td>
<td>5.1</td>
<td>.205</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cycles 2.47 (1.29) 2.72 (2.43) 2.086 (14.0) 778</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycles 2.16 (1.28) 3.28 (2.39) 0.780 (5.2) 509</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Pudding</td>
<td>Time (sec) 2.73 (1.12) 4.26 (2.91) 1.536 (11.8) 551</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Time (sec) 2.46 (1.34) 6.06 (3.03) 2.429 (8.0) .041</td>
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<tr>
<td></td>
<td>Cycles 2.49 (1.22) 3.22 (2.58) 0.801 (13.1) 437</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycles 2.04 (0.68) 4.40 (3.32) 1.556 (4.3) 190</td>
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<tr>
<td>Viscous Orange gelatin(^b)</td>
<td>Time (sec) 5.56 (2.01) 5.19 (2.95) -0.328 (18.0) 747</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Time (sec) 3.58 (1.52) 6.80 (3.28) -1.990 (8.0) 802</td>
<td></td>
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<tr>
<td></td>
<td>Cycles 5.06 (3.18) 4.50 (2.21) 2.908 (18.0) &lt;0.009</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycles 3.52 (1.09) 5.48 (2.72) -1.498 (5.3) 192</td>
<td></td>
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</tr>
<tr>
<td>Strawberry gelatin</td>
<td>Time (sec) 5.11 (2.44) 6.63 (3.86) 1.167 (11.5) 267</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Time (sec) 4.70 (2.01) 8.56 (4.48) -1.756 (8.0) .117</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Cycles 7.11 (2.68) 6.90 (3.37) -0.521 (18.0) 609</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycles 5.04 (2.16) 7.75 (4.04) -1.327 (8.0) 221</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Solid Graham biscuit(^b)</td>
<td>Time (sec) 4.94 (1.04) 1.39 (3.02) 2.665 (12.7) &lt;0.020</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Time (sec) 14.52 (5.75) 16.46 (7.69) -0.452 (8.0) 664</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Cycles 11.87 (1.25) 14.55 (3.88) 1.249 (14.1) 232</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycles 15.58 (3.23) 15.48 (8.04) 0.542 (5.3) 610</td>
<td></td>
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<tr>
<td></td>
<td>Time/cycles 0.74 (0.14) 1.30 (1.01)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Time/cycles 0.91 (0.21) 1.68 (1.41) 0.407 (5.3) 513</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Solid Arrowroot biscuit</td>
<td>Time (sec) 8.18 (2.11) 17.35 (8.52) 3.304 (10.1) &lt;0.008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Time (sec) 14.68 (6.67) 20.02 (10.04) -0.990 (8.0) 351</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cycles 11.74 (3.20) 16.43 (6.04) 2.012 (13.0) 066</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cycles 16.28 (4.35) 16.58 (7.68) -0.067 (8.0) 948</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time/cycles 0.71 (0.11) 1.07 (0.40)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Time/cycles 0.88 (0.10) 1.26 (0.51) 0.411 (5.3) 513</td>
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</tbody>
</table>

\(^a\)Standard textures

\(^b\)Wilcoxon signed rank test

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Discussion

Substitution of Standard Textures

Our most important question was whether substitute food textures could be used during standard testing when children refuse standard food textures. Our clinical impression was that foods of similar texture could be readily interchanged, but findings showed otherwise. Children without disabilities responded differently to substitutes than children with cerebral palsy (see Table 4). In children without disabilities, the pureed and viscous textures can be replaced by the specific substitute, whereas the solid texture, the graham biscuit, should not be replaced by an arrowroot biscuit. Thus, a baseline may fluctuate when substitutes for established standards are used, so foods should not be arbitrarily exchanged unless their suitability has been tested. Among children without disabilities, 62.5% ate the standard puree texture and 60% ate the standard viscous texture in a shorter amount of time than the substitute texture, whereas 70% ate the solid substitute texture (arrowroot biscuit) in a significantly shorter amount of time than the standard texture (graham biscuit).

During standard assessment of children with cerebral palsy, pudding should not be used to replace applesauce. However, the viscous and solid textures that were used in this study may be interchanged. Seventy percent of the children with cerebral palsy ate all three standard textures in a shorter amount of time than the substitute texture, whereas 70% ate the solid substitute texture (arrowroot biscuit) in a significantly shorter amount of time than the standard texture (graham biscuit).

Table 4
Food Substitutes That Can Be Used for Standard Testing in Children With Cerebral Palsy and Children Without Disabilities

<table>
<thead>
<tr>
<th>Texture</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without disabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applesauce* = Pudding</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Viscous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange gelatin* = Strawberry gelatin</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Solid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graham biscuit* = Arrowroot biscuit</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>With cerebral palsy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applesauce* = Pudding</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Viscous</td>
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<tr>
<td>Orange gelatin* = Strawberry gelatin</td>
<td></td>
<td>X</td>
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<tr>
<td>Solid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graham biscuit* = Arrowroot biscuit</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Standard textures

be generalizable to children with eating impairments. Although the difference in time for eating both solid textures in children without disabilities was small (see Table 2), this difference was significant because the variation in each group also proved to be very small. The robustness of the eating measures is consistent with earlier data by Schwartz, Niman, and Gisel (1984) and Schwab, Niman, and Gisel (1986). Although certain qualities such as taste (sweetness) and hardness seemed similar in the two biscuits, there may still be a difference in flavor or granularity of the texture that might have contributed to how long each bite was chewed and savored. Thus, our findings strongly suggest that under conditions of standardized testing, foods should not be arbitrarily interchanged unless an objective determination of their suitability has been made. Other food substitutions may lead to differences.

Applesauce and pudding can be interchanged for eating assessment standards with children without disabilities, but they should not be exchanged in children with eating impairments. The time data suggest that applesauce may be less viscous and so can be eaten in a shorter time than pudding, which may be more viscous. In addition, the cycle data suggest that pudding is eaten with greater effort (more cycles) than applesauce, particularly in the child with moderate impairments. Thus, children with eating impairments may be more sensitive than children without disabilities to small changes in food consistencies, other characteristics of the food, or both. A problem of accurately assessing ingestion of purées is that children usually savor and swallow a spoonful of puree in approximately two cycles. Thus, if one rater scores 1 cycle and the second rater scores 2 cycles, the error of this measurement is 50%. If, however, two raters disagree on 1 cycle out of 20 cycles chewed on a bite of graham biscuit, the error rate is only 5%. The problem of attaining accuracy at the lower end of a defined behavior no doubt contributes to the lower reliability score for purées than the other textures. However, this problem is not unique to our assessment method; it has been described by other investigators dealing with eating assessment (Reilly, Skuse, Mathisen, & Wolke, 1993).

Only one of the texture comparisons was significant (time-pudding) when children with cerebral palsy were categorized as having mild or moderate eating impairments. In general, children with moderate eating impairments take longer than those with mild impairments to eat pureed and viscous textures and, although the time needed for eating a solid texture is also longer, the proportional increase is shortest in solid textures and longest in the viscous and pureed textures. These findings support our earlier contention that the thinner and more liquid a food substance becomes, the more difficult it is to control motorically (Gisel, 1998). The therapeutic implication for children with eating impairments is that cohesive (tacky) food textures will be easier to manipulate orally than thinner food textures.
Chewing vigor for viscous and solid textures in general is markedly reduced in children with eating impairments, as reflected by a ratio of time to cycles (t: c) that is greater than one. The t: c ratio is less than 1 in children without disabilities. Clinically, children with more severe eating problems show higher t: c ratios than children with milder problems (see Table 3). The usefulness of this ratio in determining a cutoff point when children's nutritional status will be compromised due to their inability to chew with adequate vigor merits further investigation. Some authors have argued that children with severe oral motor deficits should be given mashed food because it can be eaten more efficiently. However, children's ability to sustain age-appropriate weights when given mashed foods has not been addressed (Croft, 1992; Jones, 1989).

**Significance of Food Textures in Other Domains**

Early attempts at rating mechanical parameters of food textures were made for commercial purposes (Szczesniak, Brandt, & Friedman, 1965), but their use was not pursued in other domains until recently. Although clinicians have long used various food textures therapeutically to elicit specific oral motor behaviors, the use of food textures for diagnostic purposes in conjunction with videofluorography is a more recent development (Alphonce-Schweizer & Gisel, 1994; Gisel & Patrick, 1988). Other technologies, such as videofluoroscopy, also use different food textures for diagnostic purposes. Videofluoroscopy offers the advantage of visualizing and identifying the anatomic region and phase of ingestion related to a specific eating problem (Gisel, Applegate-Ferrante, Benson, & Bosma, 1993; Griggs, Jones, & Lee, 1989; Kramer, 1985; Rogers, Arvedson, Buck, Smart, & Msall, in press). However, a disadvantage of videofluoroscopy is the exposure of young children to radiation (Logemann, 1986). Nevertheless, some authors base their choice of food texture on videofluoroscopic examination to determine which texture is safest to swallow without aspiration (Griggs et al., 1989; Helfrich-Miller, Rector, & Straka, 1986).

The goal of using various food textures therapeutically is to achieve more mature feeding skills. Of equal importance should be the monitoring of children's weight to determine whether ingestive skills are adequate to meet growth demands. Recent work in our laboratory has indicated that children with moderate eating impairments make some progress in eating after sensorimotor therapy that employed specific food textures therapeutically. However, children showed no catch-up growth; that is, their weight did not rise above their pretreatment growth trajectory (Gisel, 1993, in press). The therapeutic effect of sensorimotor treatment with children with mild eating impairments still needs to be determined.

In summary, the use of different food textures for diagnostic purposes is now well described (Alphonce-Schweizer & Gisel, 1993). The limitations for using food textures interchangeably during standard testing have been defined in this study. The standard viscous and solid textures may be interchanged, whereas applesauce, the standard puree, should not be replaced with pudding. The specific use of certain food textures in oral motor therapy is also much better understood (Gisel, 1993, in press), but the purported benefits of oral motor therapy must always be judged against a child's progress in growth.

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