Effects of the reappearance of primitive reflexes on eating function and prognosis

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Aim: Primitive reflexes can reappear with diseases of the brain, particularly those affecting the frontal lobes. Most studies on primitive reflexes have reported an association between such reflexes and brain damage, and the clinical symptoms of dementia. These reflexes can also be present during eating; however, their effects on eating function are difficult to evaluate. The purpose of the present study was to identify the frequency at which primitive reflexes reappear in elderly people, and to determine the effects that such reflexes have on eating function, nutritional status and prognosis.

Methods: We followed 121 nursing home residents for 6 months. All patients required long-term care and were examined for the presence of a sucking reflex, snout reflex and phasic bite reflex for baseline measures. Demographic characteristics, physical and cognitive function, and nutritional status were obtained from chart reviews, interviews with nurses, and a brief physical examination at baseline and incidence of aspiration pneumonia during the study period.

Results: The sucking reflex was confirmed in 31 patients (25.6%), snout reflex in 15 patients (12.3%) and phasic bite reflex in 28 patients (23.1%). One or more of these reflexes was identified in 38 patients (31.4%). A relationship between the presence of a primitive reflex and nutritional status was shown. An association with the presence of these reflexes and the development of aspiration pneumonia during 6 months was also confirmed.

Conclusions: The appearance of primitive reflexes appears to be associated with the risk of malnutrition and developing aspiration pneumonia. Geriatr Gerontol Int 2014; 14: 190–197.

Keywords: dementia, dysphagia, elderly people, nutrition, primitive reflexes.

Introduction

Primitive reflexes are observed during the neonatal and infant periods, but later they recede as a result of cerebral cortex inhibition and brain stem activity. However, they reappear in healthy elderly people and in patients with diseases of the nervous system. It is also known that the incidence at which these reflexes reappear increases with age. They can also reappear as a result of trauma to the brain. Although any combination of these reflexes is considered to be indicative of damage to cognitive function, it is believed that this relationship is a result of age and is not in itself specific for brain disease. It has been reported that in cases of Alzheimer’s disease or cerebrovascular dementia, a relationship can be identified between the appearance of primitive reflexes and the severity of damage to cognitive function. In contrast, no association with a decline in cognitive function has been recognized.

The major primitive reflexes in the oral cavity are the sucking reflex, snout reflex and phasic bite reflex. Most studies on primitive reflexes to date have reported an association between such reflexes and brain damage, and the clinical symptoms of dementia. As these reflexes can also be recognized during eating, their effects on eating function cannot be ignored. Nevertheless, the association between these reflexes and eating function...
or nutritional status is unknown. In the many studies of elderly patients in long-term care, there is a high incidence of malnutrition. Problems associated with malnutrition include reduced immunity and increased susceptibility to infection. Malnutrition is also a risk factor for respiratory tract infections, including aspiration pneumonia and in-hospital infections. Furthermore, it has been found that malnutrition can result from masticatory disorders due to tooth loss, but there have been no reports of malnutrition resulting from masticatory disorders due to motor impairment.

The purpose of the present study was to determine the incidence of primitive reflexes in older adults living in nursing homes, and to identify the effects of such reflexes on eating function, nutritional status and prognosis.

Methods

The participants were 121 of 127 elderly patients who lived in two nursing homes in Tokyo, Japan, and who required care (mean age 86.1 ± 7.9 years; 33 males [81.6 ± 8.3 years]; 94 females [87.7 ± 7.2 years]). Individuals under nutritional management by feeding tube were excluded.

The criterion for patient selection was that physical symptoms and cognitive impairment must have been stable for the preceding 3 months. During this 3-month period, no patient had acute disorders (e.g. severe infection, heart failure, or stroke requiring special treatment or intensive care).

In addition, the association between primitive reflexes and nutritional status was examined in 110 participants (mean age 86.2 ± 7.6 years; 30 males [82.4 ± 7.6 years]; 80 females [87.7 ± 7.2 years]) whose serum albumin could be measured. Under the approval of the Ethics Committee in the School of Life Dentistry, Nippon Dental University, the present study was carried out after obtaining informed consent from the participants or their families. The Clinical Dementia Rating (CDR) was used for evaluating cognitive functions, and the Barthel Index was used for evaluating activities of daily living (ADL). The basic survey was conducted in May 2009 and the subjects were then observed over the course of the next 6 months.

The protocol for this study was approved by the Ethics Committee of the Nippon Dental University School of Life Dentistry at Tokyo (#09–11).

Primitive reflex evaluation methods

The presence of primitive reflex was evaluated at the beginning of the present study.

Using the methods of Paulson, participants were examined in the mornings in a quiet room of the nursing home for the presence or absence of a sucking reflex, snout reflex or phasic bite reflex.

Primitive reflexes were evaluated as follows by the same dentist:

- **Sucking.** Incomplete sucking, with only weak contraction of the orbicularis oris muscle, or full sucking, with sucking movements of the tongue and pharynx, after the tip of the patient’s index finger is firmly placed between his closed lips.
- **Snout.** Weak puckering or protrusion of the lips, with elevation of the lower lip, after the examiner taps lightly on the midline of the subject’s upper lip with his index finger.
- **Phasic bite.** Vertical movement of the lower jaw, as in mastication, after the examiner presses downward with one finger on the molar region of the lower jaw.

Physical and oral examinations

**ADL and cognitive functions**

In the results of evaluation using the Barthel Index, ADL was considered stable at 45 points or more, but as having declined at 40 points or less. In the present study, based on the results of evaluation by CDR, cognitive function was considered normal at code 1 or lower, and decreased at code 2 or higher.

**Nutrition indicators**

Nutritional status was evaluated at baseline.

Bodyweight and height were measured and body mass index (BMI) was calculated. In addition, blood samples were taken for the measurement of serum albumin. Values less than 3.5 mg/dL were considered to indicate malnutrition. The texture of the food served at each of the nursing homes was also recorded. Participants who could not ingest an adequate amount of calories as a result of dysphagia were supplemented with high-calorie foods; the participants supplemented with ≥200 kcal per day were assigned to a dietary supplementation group.

**Swallowing function**

Participants were asked to swallow 3 cc of water and underwent auscultation of the cervical area after swallowing. If choking was produced in conjunction with swallowing or if a wet or gargling sound was detected by auscultation, the participant was considered to have dysphagia.

**Other**

Medical information at the nursing facilities was examined in order to determine whether the participants had
a history of aspiration pneumonia over the past 12 months. Aspiration pneumonia was diagnosed by a medical doctor.

**Statistical analysis**

For comparison of two groups, unpaired t-tests were used. To examine the independence of each group, χ²-tests were used. The presence or absence of malnutrition and the development of aspiration pneumonia during 6 months were evaluated as dependent variables. Associated factors were screened by means of logistic regression analysis. For the selection of variables, the stepwise method was applied. All statistical analyses were carried out using the Japanese version of SPSS for Windows (version 16; IBM Japan, Tokyo, Japan), and P-values less than 0.05 were considered to be significant. Numerical values in this text are expressed as mean ± standard deviation.

**Results**

The mean ages of the participants were 87.7 ± 7.2 years for females and 81.6 ± 8.3 years for males, which was a significant difference (P < 0.001). The mean Barthel Index was 29.6 ± 27.2; 41.9 ± 28.9 for males and 27.2 ± 25.5 for females, which was significantly different (P < 0.05). No sex-based differences in CDR were noted.

**Present rate of primitive reflexes**

The sucking reflex was noted in 31 (25.6%) participants (mean age 87.7 ± 8.3 years), the snout reflex was found in 15 (12.4%) participants (mean age 86.8 ± 9.3 years) and the phasic bite reflex was found in 28 (23.1%) participants (mean age 86.8 ± 7.6 years). All three reflexes were observed in 11 (9.0%) participants (mean age 89.6 ± 6.8 years). The sucking reflex plus the snout reflex were present in three (2.5%) participants (mean age 81.0 ± 13.8 years), the sucking reflex plus the phasic bite reflex were found in one (73.0 years) participant, the sucking reflex alone was noted in seven (5.8%) participants (mean age 90.0 ± 5.9 years) and the phasic bite reflex alone was noted in six (5.0%) participants (mean age 85.7 ± 2.1 years); the snout reflex alone was not observed in any participants. One or more of these reflexes were found in 38 (31.4%) participants (mean age 86.9 years).

**Relationship between primitive reflexes and characteristics**

The presence of primitive reflexes was observed in a large number of participants who had a decline in cognitive function and/or a reduction in ADL. It was also recognized that a significant number of participants often ate foods in which the food texture was modified. In those who showed the sucking reflex, insertion of dentures in either the upper or lower jaw was very difficult. No relationship between age and the appearance of primitive reflexes was noted (Table 1).

**Primitive reflexes and nutritional status**

A relationship was found between the presence of primitive reflexes and current bodyweight (sucking reflex P = 0.042; snout reflex P = 0.028). In addition, a relationship was observed between the appearance of the phasic bite reflex at 6 months or 12 months and the rate of change in bodyweight (6 months P = 0.009; 12 months P = 0.042). The presence of the sucking reflex and phasic bite reflex was also related to serum albumin levels (sucking reflex P = 0.015, phasic bite reflex P = 0.0001). Participants who had any of the primitive reflexes showed a relationship between bodyweight and serum albumin levels (bodyweight P = 0.022, serum albumin level P = 0.0001; Table 2).

A serum albumin level of less than 3.5 mg/dL was considered to show malnutrition, and the relationship with each evaluation parameter was investigated.

The following results were obtained: presence/absence of assistance in eating (P = 0.003), sucking reflex (P = 0.005), snout reflex (P = 0.02), phasic bite reflex (P = 0.001), participants with some type of primitive reflex (P = 0.003) and age (76 participants with adequate nutrition, aged 85.1 ± 7.8 years; and 34 participants with malnutrition, aged 88.7 ± 6.7 years; P = 0.025). Malnutrition, viewed in terms of serum albumin levels, was taken as the response variable. Significant parameters (assistance in eating, some type of primitive reflex and age) were taken as explanatory variables, and in the logistic regression analysis, age and appearance of some type of primitive reflex were selected as significantly independent explanatory variables (age: exp = 1.070, 1.007–1.137, P = 0.029; some type of primitive reflex: exp = 3.886, 1.582–9.545, P = 0.003; Table 3).

**Relationship between primitive reflexes and developing aspiration pneumonia**

In the course of the study, 22 participants with a mean age of 86.9 ± 8.8 years (9 males: mean age 83.6 ± 6.6 years; 13 females: mean age 89.1 ± 9.6 years) developed aspiration pneumonia. The relationship between each evaluation parameter and the onset of aspiration pneumonia was investigated. Relationships were identified between aspiration pneumonia onset and ADL (P = 0.026), sucking reflex (P = 0.022), phasic bite reflex (P = 0.009), and some type of primitive reflex (P = 0.011; Table 4).
Table 1  Relationship between primitive reflexes and basic information

<table>
<thead>
<tr>
<th></th>
<th>Suck reflex</th>
<th>Snout reflex</th>
<th>Phasic bite reflex</th>
<th>One or more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-</td>
<td>+</td>
<td>P-value</td>
<td>-</td>
</tr>
<tr>
<td>Sex (male/female)</td>
<td>27/63</td>
<td>5/26</td>
<td>0.16</td>
<td>30/76</td>
</tr>
<tr>
<td>Age, years (mean ± SD)</td>
<td>85.8 ± 7.7</td>
<td>87.7 ± 8.3</td>
<td>0.25</td>
<td>86.2 ± 7.7</td>
</tr>
<tr>
<td>BI (&lt;45/≥40)</td>
<td>59/31</td>
<td>29/2</td>
<td>0.00</td>
<td>74/32</td>
</tr>
<tr>
<td>CDR (&lt;1/≥2)</td>
<td>30/60</td>
<td>1/30</td>
<td>0.07</td>
<td>30/76</td>
</tr>
<tr>
<td>Food (solid/modified)</td>
<td>17/73</td>
<td>2/30</td>
<td>0.04</td>
<td>18/88</td>
</tr>
<tr>
<td>Swallowing disorder (yes/no)</td>
<td>68/22</td>
<td>20/11</td>
<td>0.25</td>
<td>80/26</td>
</tr>
</tbody>
</table>

BI, Barthel Index; CDR, Clinical Dementia Rating.

Table 2  Relationship between primitive reflexes and nutritional status

<table>
<thead>
<tr>
<th></th>
<th>Suck reflex</th>
<th>Snout reflex</th>
<th>Phasic bite reflex</th>
<th>One or more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-</td>
<td>+</td>
<td>P-value</td>
<td>-</td>
</tr>
<tr>
<td>Bodyweight</td>
<td>45.67 ± 8.39</td>
<td>42.27 ± 6.38</td>
<td>0.04</td>
<td>45.40 ± 8.15</td>
</tr>
<tr>
<td>BMI</td>
<td>20.43 ± 3.02</td>
<td>19.58 ± 2.54</td>
<td>0.16</td>
<td>20.43 ± 2.89</td>
</tr>
<tr>
<td>Weight change rate during 6 months (%)</td>
<td>1.53 ± 5.37</td>
<td>-0.54 ± 6.4</td>
<td>0.10</td>
<td>1.19 ± 5.74</td>
</tr>
<tr>
<td>Weight change rate during 12 months (%)</td>
<td>0.90 ± 7.30</td>
<td>-1.40 ± 9.22</td>
<td>0.21</td>
<td>0.51 ± 7.93</td>
</tr>
<tr>
<td>Serum albumin (g/dL)</td>
<td>3.73 ± 0.32</td>
<td>3.56 ± 0.26</td>
<td>0.02</td>
<td>3.705 ± 0.32</td>
</tr>
<tr>
<td>Dietary supplements (yes/no)</td>
<td>75/15</td>
<td>17/14</td>
<td>0.00</td>
<td>82/24</td>
</tr>
<tr>
<td>Development of aspiration pneumonia, +/− (n = 121)</td>
<td>78/12</td>
<td>21/10</td>
<td>0.02</td>
<td>88/16</td>
</tr>
</tbody>
</table>

BMI, body mass index.
When onset of aspiration pneumonia was taken as the response variable, significant parameters were taken as explanatory variables, and logistic regression analysis was carried out. The appearance of a bite reflex was selected as a significantly independent explanatory variable (bite reflex: $\exp = 4.679$, 1.39–15.74, $P = 0.013$; Table 5).

### Discussion

Primitive reflexes appear during the developmental process of neonatal infants. Primitive reflexes are not observed clinically as the child becomes older, because they are inhibited at a higher level, namely the cerebral cortex and pyramidal tract. The disappearance of
primitive reflexes is an important sign that shows that the infant is developing normal neurological functions.\textsuperscript{18–21} However, primitive reflexes can reappear when a pathological condition is present in the central nervous system.\textsuperscript{22}

Such cases are often seen in elderly people with dementia,\textsuperscript{4} and the relationship between whether these reflexes appear with age or changes in cognitive function,\textsuperscript{4,23} and the relationship between whether these reflexes appear with cerebral disorders are under investigation. However, the relationship between these reflexes and nutritional status and prognosis remains unclear.

The results of the present research showed that elderly people in nursing homes show high rates of primitive reflexes.

Among participants with the sucking reflex, 45.1\% also showed the snout reflex, and among those with the phasic bite reflex, 67.7\% also had the sucking reflex.

Because the sucking reflex is a superficial reflex and the snout reflex is a deep reflex, they should be differentiated, but they appear together in some people.\textsuperscript{18} In the present study, these reflexes often appeared in the same person.

Mastication is controlled by suprabulbar structures, and consists of coordinated movements of masticatory organs, such as the tongue, lips, cheeks and mandible. Motor functions of these organs are known to deteriorate with age,\textsuperscript{23,24} and to influence masticatory performance.\textsuperscript{15}

Humans chew and swallow their food based on its texture, and masticatory patterns differ depending on the food.\textsuperscript{25} The basic masticatory pattern is controlled by a central pattern generator in the brainstem, supplemented by centers in the motor cortex and the basal ganglia, and modified by peripheral information from the masticatory system. Degenerative disease, and infarction lesions and hemorrhaging in these areas of the central nervous system might, thus, have profound effects on mastication. Mandibular movement observed in the phasic bite reflex is a simple up and down movement with no lateral displacement. As the simple up and down mandibular movement observed during eating occurs as a result of disorders in the cerebral cortex and basal ganglia at a higher level than the brainstem used for reference in masticatory coordination, it appears that movement controlled by the central pattern generator in the brainstem has priority. This means that this movement is clearly different from masticatory movement.

When the movement pattern cannot be changed in accordance with differences in the food texture, foods that do not require mastication, such as pureed or mashed foods, must be eaten. However, the movement observed when eating is occasionally different from mastication movement, and involves information different from decisions based on food texture.

Malnutrition is known to occur at a high frequency in the elderly that require care,\textsuperscript{7} and is a major problem that affects survival prognosis. Therefore, we investigated whether the appearance of primitive reflexes is related to malnutrition.

When primitive reflexes were observed, it was assumed that the individuals could not carry out basic masticatory movement, that they could not eat food with proper timing, food processing in the oral cavity was not sufficient and oral propulsion was not carried out. Disorders in the preparatory stage and problems in the oral stage in swallowing such foods could also affect nutritional status.

Foods with a texture that requires modification to allow consumption without swallowing are often connected with poor nutrition per unit volume, and can become a cause of malnutrition. The results of this research are important, because they show that the appearance of primitive reflexes that affect motor function in the oral cavity can be used as an indicator of nutritional status.

Elderly people with dementia show reduced eating function,\textsuperscript{26} and have numerous problems with low bodyweight.\textsuperscript{27,28} It has been reported that marked bodyweight reduction in patients with severe dementia is often associated with death as a result of aspiration pneumonia, and that many deaths as a result aspiration pneumonia occur in patients with dysphagia or abnormal behaviors, such as not chewing their food or not swallowing properly. We showed that the presence of problems in the stage before dysphagia has an effect on survival prognosis,\textsuperscript{29,30} and found that many patients

### Table 5 Results of logistic regression analysis for onset of aspiration pneumonia

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>SE</th>
<th>Wald</th>
<th>P-value</th>
<th>Relative risk</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of aspiration pneumonia</td>
<td>1.31</td>
<td>0.67</td>
<td>3.79</td>
<td>0.05</td>
<td>3.71</td>
<td>0.99</td>
<td>13.81</td>
</tr>
<tr>
<td>BI</td>
<td>-1.99</td>
<td>1.12</td>
<td>3.19</td>
<td>0.07</td>
<td>0.14</td>
<td>0.015</td>
<td>1.21</td>
</tr>
<tr>
<td>Gender</td>
<td>-1.49</td>
<td>0.66</td>
<td>5.17</td>
<td>0.02</td>
<td>0.23</td>
<td>0.06</td>
<td>0.81</td>
</tr>
<tr>
<td>Bite reflex</td>
<td>1.54</td>
<td>0.62</td>
<td>6.21</td>
<td>0.013</td>
<td>4.68</td>
<td>1.39</td>
<td>15.74</td>
</tr>
</tbody>
</table>

BI, Barthel Index; CI, confidence interval; SE, standard error.
with severe dementia often contract fatal diseases associated with eating function disorders and noted that palliative care is necessary. In such studies to date, dysphagia observed in patients with severe dementia affects the nutritional status, and is also involved in survival prognosis. However, although many of the subjects of studies carried out to date have primitive reflexes, no surveys or studies on the appearance of primitive reflexes were included in any of the previous reports. The appearance of a sucking reflex or the phasic bite reflex suggests that voluntary propulsion of food from the oral cavity to the pharynx is disturbed, and discrepancies between swallowing motion and timing occur. It is possible that the risk of accidental swallowing is increased. It has been suggested that the increased risk of accidental swallowing, together with malnutrition, affects the onset of aspiration pneumonia, which is closely connected with the survival prognosis of elderly patients.

Based on the results of the present study, it is clear that primitive reflexes appear in many patients with reduced cognitive function, and that these reflexes are related to the onset of aspiration pneumonia. Based on careful consideration, it is necessary to provide elderly people who have primitive reflexes with assistance in eating.

When eating difficulties are observed, it is necessary to take measures to prevent malnutrition, such as providing food supplements.

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Disclosure statement

No potential conflicts of interest were disclosed.

References

Principle reflexes and eating function


