Relationship between Dental Occlusion and Falls among the Elderly with Dementia

Mitsuyoshi Yoshida, DDS, PhD, Hidehiko Morikawa, DDS, Yayoi Kanehisa, MA, Zhao Yan, DDS, Tsuyoshi Taji, DDS, PhD, and Yasumasa Akagawa, DDS, PhD
Department of Advanced Prosthodontics, Hiroshima University Graduate School of Biomedical Science, Hiroshima, Japan.

Clinical significance
It has been suggested that dental occlusion may play an important role in generating an adequate posture reflex through ensuring mandibular stability. This study suggests the existence of a clear relationship between dental occlusion and falls among the elderly with dementia. Further study was, therefore, considered necessary to explore the relationship between oral health and general health.

Abstract
Purpose: Multifactorial interventions to prevent falls are relatively less effective in the elderly with dementia. We hypothesize that the primitive posture reflex associated with dental occlusion may play an important role in preventing falls in elderly persons with dementia. To demonstrate this, we compared the incidence of falls in individuals with and without dental occlusion.

Methods: This study was conducted at a special geriatric hospital for patients with severe dementia in Hiroshima, Japan. One hundred and forty-six ambulatory institutionalized elderly subjects (42 male and 104 female; mean age, 82.2 y) were divided into three groups on the basis of oral examinations: Group A, premolar and molar occlusion was maintained by natural dentition; Group B, occlusion was maintained by partial or full denture(s); and Group C, occlusion was not maintained by either natural or prosthetic teeth. Each subject was classified into either the “High Falls” (history of two or more falls during the previous one year) or “Low Falls” (history of one or no fall during the previous one year) category. In addition, a small pilot study was conducted to investigate the prevalence of falls in edentulous individuals within one year following denture delivery.

Results: During the 1-year investigation period, 41 of the 146 subjects had recurrent falls and the dental occlusion status was found to be significantly different between the “High Falls” group and the “Low Falls” group (P<0.0001). In the “High Falls” group, 10 subjects had dentures: of these, three patients were excluded because of a comatose condition or death from old age, and the remaining 7 patients experienced fewer falls during the one-year follow-up.

Conclusion: These findings suggest that dental occlusion with either natural or prosthetic teeth may play an important role in maintaining the postural reflex and preventing falls in the elderly with dementia.

Key words: dementia, falls, dental occlusion

Introduction
More than one-third of persons 65 years of age or older sustain falls each year and, in about a half of these cases, the falls are recurrent.1,2 Approximately 1 in 10 falls results in serious injury, such as hip fractures.3 Hip fractures increase the morbidity and mortality in this population, with death occurring within 1 year of a hip fracture in over 30 % of the elderly.4 Independent of other health conditions, falls restrict such daily activities as dressing, bathing, housekeeping or shopping, and increase the risk of admission of the subject to a nursing home.5,6 Therefore, prevention of falls is of primary concern for maintaining an adequate quality of life (QOL) in this rapidly increasing segment of the population.

Elderly persons with cognitive impairment and dementia have twice the risk for falls as elderly persons with normal cognitive functions.1,7 The most common risk factors for falls are impaired gait and balance (postural instability), environmental hazards, side effects of medications, and cardiovascular disease. It has been demonstrated
that multifactorial assessments and interventions focused on these risk factors may be successful in preventing falls in elderly persons with normal cognitive functions, but not in the elderly with cognitive impairment and dementia, possibly because of impaired executive control function.\textsuperscript{8,9,10} It is, therefore, considered that primitive reflexes, such as postural stability, are may be more important in the elderly with dementia.

In the upright position in humans, frequent small oscillations are generated to maintain balance. Sensorial afferent impulses are transmitted from proprioceptive, tactile, vestibular, and visual receptors. Proprioception of the masticatory muscular system arises from the masticatory muscclar system and dento-alveolar ligaments, and receives innervation from the trigeminal nerve.\textsuperscript{11} Poor or absent dental occlusion may decrease the efficacy proprioception from this area, thereby, interfering with the stability of the head posture. In one study, totally edentulous patients without dentures showed a significantly higher degree of postural swaying, as measured by a stabilometer, as compared with patients wearing dentures.\textsuperscript{12} Because postural instability increased the incidence of falls, this finding may indicate that elderly individuals without dental occlusion are at a higher risk for falls than those in whom dental occlusion is maintained.\textsuperscript{13}

In this study, we compared the incidence of falls in individuals with and without adequate dental occlusion, in terms of the rate of fall recurrence.\textsuperscript{12} In addition, in a smaller pilot study, the effect of improved dental occlusion on the incidence of falls was investigated among subjects with a history of recurrent falls. A brief report has been published elsewhere.\textsuperscript{14}

Materials and methods

The subjects of this study were 146 ambulatory elderly persons (42 male and 104 female; mean age, 82.2 y) who had been admitted to a special geriatric hospital for individuals suffering from severe dementia with behavioral disorders. The inclusion criteria were limited to those subjects who could conduct ambulatory activity with or without a cane. Multifactorial assessments of each subject’s functional, physical, mental, and pharmacotherapeutic status were performed, and occupational therapists conducted daily group rehabilitations to maintain the activities of daily living. The types of dementia among the patients included Alzheimer’s disease (AD) and vascular dementia (VD) as diagnosed by one neuropsychiatrist. The prescribed neuropsychiatric medications were recorded from each subject’s medical chart. The Mini Mental State (MMS)\textsuperscript{15} examination was performed by a clinical psychotherapist to evaluate the cognitive status. Prior approval for use of the patients’ information for this study was obtained from the ethics committee of Nakamura Geriatric Hospital.

At the beginning of the study, oral examinations were performed by one dentist who was exclusively a prosthodontist. The subjects were divided into three groups on the basis of the result of oral examination: Group A, maintained premolar and molar occlusion by natural dentition; Group B, maintained premolar and molar occlusion by partial or full denture(s); and Group C, dental occlusion not maintained by either natural or prosthetic teeth.

The subjects were also divided into two groups based on the frequency of falls: the “High Falls” group (history of two or more falls during the previous one year), and the “Low Falls” group (history of one or no fall during the previous one year). The baseline characteristics of the two groups, as determined from medical charts, mental examination and occlusal status, were compared using one-way ANOVA for continuous variables and the chi-square test for categorical variables. All the medical examinations are included in daily practice at this hospital. Oral examination was also conducted as part of the annual dental check up at this hospital. Approval was obtained from the ethics committee of this hospital to use the information on the subjects obtained for this study.

In a smaller pilot study, dentures were provided for a small subgroup of patients of the “High Falls” group who gave informed consent. After the denture delivery, the incidence of falls, as well as the walking ability and scores in the MMS were recorded for over one year after denture delivery. The incidence of falls prior to the use of dentures was compared with that during the first year after denture delivery.

Results

During the 1-year investigation period, 41 of the 146 patients had recurrent falls, and 10 patients
suffered hip fractures as a result of the fall. No differences were found between the “High Falls” group and the “Low Falls” group in terms of the sex, age, type of dementia, psychoneurotic neuropsychiatric medications or mean MMS score (Table 1). The dental occlusion status was significantly different between the “High Falls” group and the “Low Falls” group (P<0.0001) (Table 2). The risk of falls in group C was about 3.65 (range, 1.42 – 9.33) times higher than that in group A, and about 3.73 (range, 1.99 – 6.98) times higher than that in group B.

Among the subjects in the “High Falls” group, 10 subjects who gave informed consent received denture treatment. Conventional denture treatments were provided, including repair (subjects No.2, 9, 10), relining (No.5, 8), and making of new dentures (No. 1, 3, 4, 6, 7) (Table 3). All the subjects received dentures following the treatment. During the investigation period after denture delivery, 3 subjects were excluded because of a comatose condition or death from old age. All of the remaining seven patients experienced a decrease in the frequency of falls, with 5 patients experiencing one or no fall during the one-year follow-up duration.

**Discussion**

Within the limits of this study, we found that elderly subjects without dental occlusion had significantly more frequent falls than those in whom occlusion was maintained with natural teeth and/or dentures.

Other studies have demonstrated that specific recommendations by an occupational therapist and follow-up to eliminate home hazards are associated with a substantial reduction in the risk of falls. Our survey was conducted in a special geriatric hospital for dementia, an environment that is strictly controlled under the public health insurance guidelines to prevent falls.

It has been shown that falls result from various combinations of factors, including the use of multiple medications that impair balance, vision and/or cognition. Perhaps the most controversial component of the strategies to prevent falls involves reduction in the use of medications. Prevention of falls must be weighed against the risk of poor neuropsychiatric control. The subjects in this study suffered from severe dementia with behavioral problems. Reduction of the ad-

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**Table 1** Comparison of the variables between the “High Falls” group and “Low Falls” groups. There were no significant differences in any of the variables listed in this table between the “High Falls” group and the “Low Falls” group. AD: Alzheimer’s disease, VD: Vascular dementia, MMS: Mini Mental Status examinatio.

<table>
<thead>
<tr>
<th>Variables</th>
<th>“High Falls” group</th>
<th>“Low Falls” group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex(male / female)</td>
<td>10/31</td>
<td>32/73</td>
</tr>
<tr>
<td>Age</td>
<td>83.1±6.4</td>
<td>81.9±6.9</td>
</tr>
<tr>
<td>Dementia(AD / VD / other)</td>
<td>15 / 6 / 20</td>
<td>39 / 27 / 39</td>
</tr>
<tr>
<td>Medication(Yes / No)</td>
<td>23 / 18</td>
<td>65 / 40</td>
</tr>
<tr>
<td>MMS</td>
<td>9.6 ± 6.7</td>
<td>11.8 ± 6.3</td>
</tr>
</tbody>
</table>

**Table 2** Relationship between the dental occlusal status and the frequency of falls. Significant differences in the frequency of falls classification were found between Group A and Group C and between Group B and Group C (χ²-test, P<0.0001). Group A: premolar and molar occlusion maintained by natural dentition, Group B: the occlusion maintained by partial or full denture(s), Group C: occlusion not maintained by either natural or prosthetic teeth.

<table>
<thead>
<tr>
<th>Dentition status</th>
<th>Falls Classification</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Falls</td>
<td>4</td>
<td>10</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Low Falls</td>
<td>23</td>
<td>59</td>
<td>23</td>
</tr>
</tbody>
</table>

**Table 3** Walking ability MMS and number of falls before and after denture delivery among 10 patients from the “High Falls” group.

<table>
<thead>
<tr>
<th>Subject (Sex, Age)</th>
<th>Before denture treatment</th>
<th>After denture treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Walking</td>
<td>MMS</td>
</tr>
<tr>
<td>1(Female, 83)</td>
<td>OK</td>
<td>12</td>
</tr>
<tr>
<td>2(Female, 80)</td>
<td>OK</td>
<td>13</td>
</tr>
<tr>
<td>3(Female, 91)</td>
<td>With cane</td>
<td>11</td>
</tr>
<tr>
<td>4(Female, 72)</td>
<td>OK</td>
<td>16</td>
</tr>
<tr>
<td>5(Female, 85)</td>
<td>OK</td>
<td>12</td>
</tr>
<tr>
<td>6(Female, 89)</td>
<td>With cane</td>
<td>11</td>
</tr>
<tr>
<td>7(Male, 63)</td>
<td>With cane</td>
<td>14</td>
</tr>
<tr>
<td>8(Female, 87)</td>
<td>OK</td>
<td>10</td>
</tr>
<tr>
<td>9(Male, 78)</td>
<td>With cane</td>
<td>19</td>
</tr>
<tr>
<td>10(Female, 82)</td>
<td>OK(Fugue)</td>
<td>3</td>
</tr>
</tbody>
</table>
ministration of behavior-modifying drugs would be difficult in such patients.

Because tooth loss may result in a decrease in proprioception from the masticatory muscles or dento-alveolar ligaments, an associated disturbance of visual stabilization and postural imbalances may occur.\(^1\) Yamaga et al\(^2\) indicated that a poor dental occlusal condition was associated with a reduced lower extremity dynamic strength, agility, and postural balance in elderly people. These findings suggest that functional occlusion with natural or artificial teeth may play an important role in generating an adequate posture reflex through inducing mandibular stability, consequently preventing falls. The results of our pilot interventional study in which occlusion was reconstructed with dentures supports this suggestion. We are now conducting a similar interventional study on a larger sample to further examine the relationship between occlusion and the risk of falls.

In conclusion, we suggest that poor or inadequate dental occlusion may be a predisposing factor for falls in the elderly, and that improvement of the occlusal ability deserves attention as an approach to the prevention of falls in elderly persons. It is recommended that a dental examination should be included in the standard health examination for elderly persons, especially those with symptoms of dementia.

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References

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