



Original Article

Association between number of teeth present and mandibular cortical erosion in Japanese men and women aged 40 years and older: A cross-sectional study

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Abstract

Mandibular cortical erosion detected on dental panoramic radiographs is associated with increased risk of osteoporosis in older adults. Additionally, many reports have demonstrated an association between decreased number of teeth present and osteoporosis. However, whether mandibular cortical erosion is associated with a decreased number of teeth remains unclear. The purpose of this study, therefore, was to clarify the association between mandibular cortical erosion and number of teeth present in Japanese men and women aged 40 years and older. Among patients who visited our university hospital and underwent dental panoramic radiography for the diagnosis of dental diseases, 839 patients (293 men and 546 women) aged 40–89 years (mean [SD], 63.7 [10.6] years) participated in this study. Multiple regression analysis revealed that mildly to moderately eroded cortex ($p = 0.007$) and severe eroded cortex ($p < 0.001$) were significantly associated with a decreased number of teeth present. Analysis of covariance adjusted for covariates revealed a significant association between mandibular cortical erosion category and number of teeth present ($p < 0.001$). Subjects with a severely eroded cortex had significantly fewer teeth present than those with a normal cortex (mean [SE], 20.7 [0.5] vs. 23.4 [0.3], $p < 0.001$) or mildly to moderately eroded cortex (22.2 [0.4], $p = 0.04$). Subjects with a mildly to moderately eroded cortex had significantly fewer teeth present than those with a normal cortex ($p = 0.033$). Our results suggest the significant association between mandibular cortical erosion and number of teeth present in Japanese men and women aged 40 years and older.

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Keywords: Mandible; Cortex; Panoramic radiography; Osteoporosis; Tooth

1. Introduction

Osteoporotic fractures are a crucial burden worldwide and can result in an increased risk of subsequent fractures,

morbidity, and mortality [1]. The global incidence of fractures has gradually decreased except in Asia [2]. In particular, the incidence rate of osteoporotic fractures in Japan continues to increase; there are approximately 13 million patients with osteoporosis and 170,000 femoral neck fractures occur annually [3]. One potential explanation may be insufficient identification of patients at risk of osteoporotic fractures. In fact, only 30% of patients with osteoporosis receive some type of therapy for osteoporosis in Japan [4].

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Since 1994, we have investigated the usefulness of mandibular cortical shape, namely the mandibular cortical index (MCI), detected on dental panoramic radiographs, which are widely used in general dental practice for the diagnosis of dental diseases [5]. We have demonstrated associations between the MCI and osteoporosis diagnosis determined by bone mineral density (BMD) measured by dual energy X-ray absorptiometry [6,7]; the MCI and biochemical markers of bone turnover [8]; and the MCI and risk of osteoporotic fractures [9]. Additionally, a recent meta-analysis indicated the usefulness of the MCI for identification of asymptomatic individuals at risk of osteoporosis [10].

Daniell demonstrated the association between osteoporosis and increased risk of tooth loss in postmenopausal women [11]. Since then, many investigators have confirmed the association between osteoporosis and tooth loss in the elderly worldwide, including Japan and Korea [12–14]. Furthermore, Wactawski-Wende suggested a potential mechanism by which systemic bone density loss during osteoporosis may provide a host system that is increasingly susceptible to destruction of periodontal tissue by infection, resulting in tooth loss [15]. Nevertheless, if a positive association between osteoporosis and tooth loss exists, then it is likely that the MCI detected on dental panoramic radiographs may be associated with number of teeth present in the elderly. The purpose of this study, therefore, is to clarify the association between the MCI and number of teeth present in Japanese men and women aged 40 years and older.

2. Materials and methods

2.1. Subjects and panoramic radiography measure

Among patients who visited our university hospital and underwent dental panoramic radiography for the diagnosis of dental diseases between January 2007 and December 2013, 2187 men and women aged ≥ 40 years were invited to complete a structured questionnaire. Patients who refused to provide written informed consent, had destructive jaw lesions such as osteomyelitis and malignant tumors, or were receiving cancer medications were excluded from the study. The subjects completed the structured questionnaire, which collected information regarding body height (cm), body weight (kg), history of smoking and alcohol consumption, history of hypertension, diabetes mellitus, and rheumatoid arthritis, daily number of tooth brushings (< 2 or ≥ 2), use of inter-dental brush or floss, and use of osteoporosis medications. We selected the factors included in the covariance from FRAX [16]. Additionally, since we previously demonstrated the significant association between loss of teeth and hypertension, we collected the information about hypertension [17].

Dental panoramic radiographs were obtained with an AZ-3000 instrument (Asahi, Kyoto, Japan). Four experienced radiologic technologists took these radiographs. A digital radiography system (Regius Model 170; Konica Minolta Holdings, Tokyo, Japan) was used for the radiographs in all subjects. The panoramic radiographs were prepared using a

laser imager (Drypro SD-P, Konica Minolta Holdings, Tokyo, Japan). All the panoramic radiographs used in this study were suitable for taking the measurements. MCIs of all dental panoramic radiographs were determined by an oral radiologist (A.T., with 26 years clinical experience) who was blinded to the number of teeth present by masking the alveolar bone area of the jaws.

The MCI was determined by observing the mandible distally from the mental foramen bilaterally and categorized into one of three groups as previously described [6]: normal cortex: the endosteal margin of the cortex is even and sharp on both sides; mildly to moderately eroded cortex: the endosteal margin shows semilunar defects (lacunar resorption) or appears to form endosteal cortical residues; severely eroded cortex: the cortical layer forms heavy endosteal cortical residues and is clearly porous (Fig. 1). The number of teeth present was counted on dental panoramic radiographs by another dentist (S.Y.). This study was carried out in accordance with the Declaration of Helsinki. The ethics committee of our university reviewed and approved the study protocol (No. 0152). Written informed consent was obtained from all subjects prior to enrollment.

2.2. Statistical analysis

Main observer (A.T.) and another observer (K.U.) independently determined MCIs of 200 dental panoramic radiographs randomly selected from those of the participants. Intra- and inter-observer agreement was calculated by the weighted kappa statistic, respectively. Continuous variables are expressed as means \pm standard deviation (SD). The Chi-squared test or one-way analysis of variance was used to investigate differences in number of teeth present, age, gender, body height (cm), body weight (kg), history of smoking (yes or no) and alcohol consumption (yes or no), history of hypertension (yes or no), diabetes mellitus (yes or no), and rheumatoid arthritis (yes or no), daily number of tooth brushings, use of inter-dental brush or floss (yes or no), and use of osteoporosis medications (yes or no) among the three MCI categories. Multiple regression analysis in a step-wise manner, adjusted for the abovementioned variables, was used to clarify the association between number of teeth present and MCI category. Dummy variables were used for categorical data in this multiple regression analysis.

Analysis of covariance (ANCOVA), adjusted for age, gender, body height (cm), body weight (kg), history of smoking (yes or no) and alcohol consumption (yes or no), history of hypertension (yes or no), diabetes mellitus (yes or no), and rheumatoid arthritis (yes or no), daily number of tooth brushings, use of inter-dental brush or floss (yes or no), and use of osteoporosis medications (yes or no), was used to evaluate differences in the number of teeth present among the three MCI categories. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS, version 19.0; IBM Inc., Armonk, NY, USA). P values < 0.05 were considered to indicate statistical significance.

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