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# Survey on awareness and perceptions of bisphosphonate-related osteonecrosis of the jaw in dental hygienists in Seoul

**Abstract:** We investigated awareness in dental hygienists of bisphosphonate-related osteonecrosis of the jaw (BRONJ) in patients with osteoporosis and cancer and assessed the situation in systemic history investigations to broaden the scope of the dental hygienists' BRONJ awareness as a basis for contributing to preventing this disease. The study was carried out through a survey; 217 dental hygienists responded to the survey. They worked at 12 university and general hospitals, 10 dental hospitals and 35 dental clinics, for a total of 57 institutions in Seoul. The survey consisted of 37 questions: general characteristics (*J Oral Maxillofac Surg* 65: 2007; 369), systemic history investigations (Ruggiero *et al. J Oral Maxillofac Surg* 62: 2004; 527) and awareness of BRONJ (Park *et al. J Korean Dent Assoc* 49: 2011; 389). Among them, 79.7% were aware of BRONJ. Recognition was highest among those from 25 to 35 years old ($P < 0.05$). In terms of work experience, those with 5–10 years experience showed the highest awareness ($P < 0.05$). In terms of institutions type, dental clinics showed lower awareness than general and dental hospitals ($P < 0.05$). It was found that 55.3% of the dental hygienists had been educated about BRONJ. Those aged 25–35 years were the most educated. In terms of institutions, dental clinic staff were the least educated. The degree of understanding about BRONJ was analysed with the average score of 6.14 points. According to these results, dental hygienists working in university hospitals and general hospitals had more opportunity to receive training than those working in dental clinics. Thus, it is considered that the development of professional training programs about BRONJ for all dental hygienists is necessary.

**Key words:** awareness; bisphosphonate-related osteonecrosis of the jaw; dental hygienist; institution; perception

## Introduction

Korea has recently become a rapidly ageing society; according to the National Statistical Office in 2013, those aged 65 years or older accounted for 12.2% of the population, and this ratio is expected to continue to increase gradually. One problem due to the ageing population is an increase in chronic diseases. In particular, the number of patients with osteoporosis and related fracture continues to grow. The prevalence of osteoporosis, according to a 2008 statistical survey, was 10.3% of the population over the age of 65 (1). The most commonly used drugs in

the treatment of osteoporosis are bisphosphonates (2) that inhibits the function of osteoclasts, increasing bone density (3). Bisphosphonates are used to treat Paget's disease, multiple myeloma and in the prevention of bone metastasis of malignant tumours. They have distinct fracture-prevention efficacy, excellent economic cost-effectiveness and work selectively in bone tissue (3). However, in the dental field, bisphosphonate side effects can include delayed healing of soft and hard tissue, teeth mobility, oedema, infection, bony exposure after oral minor surgery and sensory disturbances after extractions (5).

In 2003, Marx reported avascular bone necrosis in 36 patients treated with bisphosphonates, beginning our awareness of the severity of the side effects of bisphosphonates. Since then, reports about 'bisphosphonate-related osteonecrosis of the jaw' (BRONJ) have increased (6, 7–8).

The American Association of Oral and Maxillofacial Surgeon (AAOMS) published a position paper about the risk of ONJ in 2007, 2009 and 2014 (9, 10, 23).

In 2009, The Korean Society for Endocrinology, The Korean Society for Bone and Mineral Research, The Korean Society for Osteoporosis and The Korean Association of Oral and Maxillofacial Surgeons issued a combined report about BRONJ occurrence risk, prevention and treatment to doctors and dentists.

The exact pathogenesis of BRONJ remains unclear, although several hypotheses have been proposed. One is that significant inhibition of osteoclasts can lead to localized fine fractures and a weak structure that is vulnerable to impact damage, such as in extractions, and interfere with the normal bone turnover process (8, 12, 13). This is supported by the fact that osteonecrosis of the jaw due to bisphosphonates occurs frequently in the maxillary and mandibular bone where remodelling is active (13).

Awareness regarding BRONJ seems to be lacking, possibly because predicting the occurrence of BRONJ and treatment after occurrence are difficult even though the diseases have received a lot of attention from doctors and dentists (14). BRONJ can be expected to occur more frequently, given that the number of elderly patients receiving bisphosphonates continues to increase (15), but simple awareness of BRONJ and the potential for triggering BRONJ were only reported in 56.5% and 28.9% of respondents, respectively, and a medical examination including interview questions about taking bisphosphonates was only seen in under 15% (14). In this study, we analysed variables affecting recognition of BRONJ, level of education about BRONJ and perceptions of BRONJ in dental hygienists working in hospitals and clinics in Seoul through a questionnaire investigation. We also intended to analyse actual conditions in medical history investigations and assess the significance of the investigation as a basis to prevent bone necrosis.

## Subjects and methods

### Subjects

This study involved Seoul-based dental institutions as of July 2013 and included dental teaching hospitals under teaching hospitals and medical teaching hospitals, superior general hospitals and general hospitals under general hospitals and excluded dental hospitals under dental and medical colleges.

### Methods

This research was approved by the Institutional Review Board (IRB; ECT 13-40A-07).

The study used questionnaires that were sent to university hospitals, general hospitals, dental hospitals (250) and 250 dental clinics. In total, 500 questionnaires were delivered by personal contact, mail, the internet and e-mail.

The questionnaire consisted of 37 questions on general characteristics (9), general health conditions (7) and on awareness of BRONJ (20). The general characteristics of the responders included age, work experience, work place, number of daily patients and education completed. General health conditions referred to Nam and Park's research. There were five questions as follows: 'History taking is implemented with every patient', 'History taking is done with a detailed record of the general health condition and medications of the patients', 'History taking is done with checks on bisphosphonates drugs', 'When it is hard to take a patient's history precisely, I make a point to consult specialists in internal medicine', and 'I receive informed consent from patients after explaining possible complications'. These five questions were measured with a 5-point Likert scale: Never = 1 point, Not usually = 2, Usually yes = 3, Yes = 4 and Yes for sure = 5. A total score of 25 is possible and the higher the score, the more likely and complete is taking a general health history.

Overall awareness of BRONJ was analysed in terms of perceptions of BRONJ, degree of education about BRONJ and understanding of BRONJ. Perceptions of BRONJ were analysed by simple recognition of BRONJ, and degree of education was divided into presence of education and process for education on BRONJ. Understanding of BRONJ was assessed with 10 questions, referring to study from Park *et al.* (14). One point is given for questions answered 'yes' and zero for 'no' or 'do not know.' Thus, the total score can vary from 0 to 10, and a higher score indicates a higher understanding of BRONJ.

Additionally, factors that influenced understanding of BRONJ were analysed according to the general characteristics of the responders.

### Statistical analysis

The subjects' general characteristics, medical history and awareness of BRONJ are presented as frequencies and percentages. For subjects from different work places, subjects with different general characteristics, and simple recognition of BRONJ and the presence of education, we used a chi-square and Bonferroni correction. To determine factors that influenced the understanding of BRONJ, multiple linear regression analysis was used regarding the general characteristics. Data were analysed using the SPSS software ver. 18.0 (IBM Inc., Il, USA). Statistical significance was set at $P < 0.05$.

# Results

### Subjects

The results came from 12 university hospitals and general hospitals, 10 dental hospitals and 35 dental clinics. We received results from a total of 217 dental hygienists, working at 57 institutions (Table 1). Among the 500 questionnaires, 127 were not returned, 143 were from false responders (ex–Hospital coordinator, nurse's side), and 13 questionnaires were inadequately completed in form; they were all excluded, and 217 questionnaires were analysed.

### Medical history taking

#### *How to take a medical history*

As a result of the investigation on medical history taking, patients directly recorded 24.88% or dentists recorded 16.13% histories at university or general hospitals.

In dental hospital, 10.60% patients and 4.15% dentists recorded them directly.

In dental clinics, 10.14% patients and 4.15% dentists directly answered the questions. In addition, in dental clinics, more dental hygienists (21.66%) answered them directly, and these numbers differed depending on the work places ($P < 0.05$).

### Awareness of BRONJ

From the results on the awareness of BRONJ, 173 of 217 responders were aware of BRONJ, and 44 were not. There was a significant difference in BRONJ awareness by age ($P < 0.05$). Additionally, there were significant differences according to work experience and work places ($P < 0.05$; Table 2).

Bonferroni *post hoc* comparison results showed that the group under 25 years old was statistically significantly different than the groups 25–35 years old and over 35 years old ($P < 0.05$). There was also a significant difference between career length under 5 years and 5–10 years and over 10 years ($P < 0.05$). There was also a significant difference in awareness of BRONJ when dental clinics were compared with general and dental hospitals ($P < 0.05$).

### Education on BRONJ

Of the 217 respondents, 55.3% have received education about BRONJ, and 44.7% said they had not received any education on BRONJ. There were significant differences in education received by age ($P < 0.05$), work experience and work places ($P < 0.05$; Table 3). There was a significant difference when dental clinics were compared with university and dental hospitals, but no difference between university hospitals and dental hospitals ($P > 0.05$).

Table 1. **General characteristics of the subjects**

| General characteristics | Classification | *n* | % |
|---|---|---|---|
| Age | Under the age of 25 | 37 | 17.1 |
| | Over 25 and under 35 years of age | 157 | 72.4 |
| | Over 35 years of age | 23 | 10.6 |
| Work experience | Under 5 years | 99 | 45.6 |
| | 5–10 years | 84 | 38.7 |
| | Over 10 years | 34 | 15.7 |
| Institution type | University hospital/general hospital | 94 | 43.3 |
| | Dental hospital | 40 | 18.4 |
| | Dental clinic | 83 | 38.2 |
| Average number of patients per day | 10–50 | 116 | 53.5 |
| | 50–100 | 53 | 24.4 |
| | Over 100 | 48 | 22.1 |
| Number of education sessions completed | 0 | 50 | 23.0 |
| | 1–30 | 145 | 66.8 |
| | Over 30 | 21 | 9.7 |
| | Missing value | 1 | 0.5 |
| Sum | | 217 | 100.0 |

Table 2. **Awareness of bisphosphonate-related osteonecrosis of the jaw. Unit: person (%)**

| | | Awareness of BRONJ | | |
|---|---|---|---|---|
| | | Aware | Not aware | *P* |
| Age | Under 25 | 16 (43.2) | 21 (56.8) | <0.001* |
| | 25–35 | 135 (86) | 22 (14) | |
| | Over 35 | 22 (95.7) | 1 (4.3) | |
| Work experience | Under 5 | 68 (68.7) | 31 (31.3) | 0.001* |
| | 5–10 | 73 (86.9) | 11 (13.1) | |
| | Over 10 | 32 (94.1) | 2 (5.9) | |
| Work place | University and General hospital | 87 (92.6) | 7 (7.4) | <0.001* |
| | Dental hospital | 34 (85) | 6 (15) | |
| | Dental clinic | 52 (62.7) | 31 (37.3) | |
| Total | | 173 (79.7) | 44 (20.3) | |

* : statistically significant difference in each age, work experience, work place categories.

Table 3. **Education bisphosphonate-related osteonecrosis of the jaw. Unit: person (%)**

| | | BRONJ education | | |
|---|---|---|---|---|
| | | Yes | No | *P* |
| Age | Under 25 | 4 (11) | 33 (89) | <0.001* |
| | 25–35 | 70 (44.5) | 87 (55.5) | |
| | Over 35 | 10 (43) | 13 (57) | |
| Work experience | Under 5 | 29 (29.5) | 70 (70.5) | 0.020* |
| | 5–10 | 41 (48.8) | 43 (51.2) | |
| | Over 10 | 12 (35.3) | 22 (64.7) | |
| Working place | University and General hospital | 67 (71.3) | 27 (28.7) | <0.001* |
| | Dental hospital | 14 (35) | 26 (65) | |
| | Dental clinic | 16 (19.3) | 67 (80.7) | |
| Total | | 120 (55.3) | 97 (44.7) | |

* : statistically significant difference in each age, work experience, work place categories.

Table 4. **Education path on bisphosphonate-related osteonecrosis of the jaw (overlapping answers)**

| Method of Education | *n* | % |
|---|---|---|
| School curriculum | 33 | 21.85 |
| Seminar | 49 | 32.45 |
| Continuing education | 16 | 10.61 |
| Education within work place | 51 | 33.77 |
| Other | 2 | 1.32 |

#### Education method on BRONJ

In terms of educational path, education within the work place showed the highest percentage (33.77%), followed by seminar organized by the institute (32.45%) and school (Table 4).

#### Understanding of BRONJ

Questions on the understanding of BRONJ consisted of 10 questions, with 1 point for 'yes,' and zero for 'no' and 'do not know.' In total, 17 answerers (7.83%) scored 0 points and 22 answerers (10.13%) received 10 points; the average score was 6.14 (Table 5).

#### Factors that influence understanding of BRONJ

To analyse whether the general characteristics of the study subjects, including age, work experience and work place, affected their understanding of BRONJ, a multiple linear regression analysis was performed. There was no statistically significant difference in age, work experience or work place.

## Discussion

In this study, we sought to evaluate dental hygienists on history-taking about systemic conditions and awareness of ONJ that occurs in patients with osteoporosis or soft tissue cancers who take bisphosphonates and to extend the awareness on BRONJ to collecting data about the prevention of this disease. The occurrence of BRONJ is 0.8–1.2% for patients with IV bisphosphonates (9, 13) and 0.00038–0.06% with oral administration (5). However, its diagnosis is not easy and it can be overlooked as simply a condition associated with oral surgery (4). Thus, correct recognition of ONJ while taking bisphosphonates is necessary. Additionally, BRONJ does not respond well to treatment; thus, it is important to prevent and diagnose the disease early (13). In surgery that involves bone exposure, such as teeth extraction and dental implants, history taking regarding risk factors for BRONJ is important, including types, amount, duration and administration method of bisphosphonates, as well as history of steroid taking and DM. Along with such history taking, a close oral examination including radiographic examination must be implemented (16).

For patients with scheduled bisphosphonate administration, the focus should be the removal of risk factors for BRONJ (13). According to the AAOMS Position Paper, bisphosphonates are associated with a higher possibility of ONJ occurrence with IV injection than oral medications. Thus, for patients with IV injections of bisphosphonates, surgical procedures are recommended only when necessary, and if BRONJ occurs, the patient should be referred to dentists with experience of BRONJ management (10, 11). Also, long-term administration increases the risk of BRONJ occurrence; the risk is lower with oral administration but it has been reported that this increases in cases of administration for over 3 years (10).

Marx (17) insisted that in BRONJ patients, C-terminal telopeptide (CTX) must be measured before invasive surgical treatment. CTX is a bone resorption marker, reflecting emission quantities of products through serum and urine. CTX levels are 400–500 pg $ml^{-1}$ in a healthy person who does not take bisphosphonates, and lower CTX levels indicate a normal bone remodelling process, that is low new bone formation (18, 19). Thus, checking the severity of osteoporosis, including

Table 5. **Understanding of bisphosphonate-related osteonecrosis of the jaw. Unit: person (%)**

| BRONJ questions | Yes | No | Do not know |
|---|---|---|---|
| The long-term administration of bisphosphonates is related to a high risk of developing BRONJ. | 176 (81.11) | 12 (5.53) | 29 (13.36) |
| Oral administration of bisphosphonates has lower risk of BRONJ than injection. | 119 (54.84) | 33 (15.21) | 65 (29.95) |
| Bisphosphonates inhibit the function of osteoclasts and bone remodelling. | 125 (57.60) | 33 (15.21) | 59 (27.19) |
| When orally administered, the risk of developing BRONJ is low, but more than 3 years of administration can increase the risk. | 104 (47.93) | 35 (16.13) | 78 (35.94) |
| Patients administered bisphosphonates may not show BRONJ after implantation; BRONJ can occur after the completion of prosthesis. | 110 (50.69) | 37 (17.05) | 70 (32.26) |
| Bisphosphonates can be left in the body for years after discontinuing the drug. | 143 (65.90) | 17 (7.83) | 57 (26.27) |
| BRONJ occurs more frequently in the mandible than the maxilla. | 116 (53.46) | 38 (17.51) | 63 (29.03) |
| BRONJ occurs after invasive dental treatment and shows the highest occurrence with extraction sockets. | 147 (67.74) | 15 (6.91) | 55 (25.35) |
| It is recommended for patients with BRONJ to discontinue the use of bisphosphonates. | 131 (60.37) | 25 (11.52) | 61 (28.11) |
| The treatment of BRONJ seeks to relieve pain, inhibit hard and soft tissue infection and minimize bone necrosis. | 162 (74.65) | 9 (4.15) | 46 (21.20) |

recent bone density measurements through consultation, assessing risk factors, checking CTX levels and consultations as to whether drug replacement is possible before treatments is necessary (20).

Prevention is the best treatment for BRONJ because there is no efficacious treatment. It is recommended that dental staff must ask a patient about experience of taking bisphosphonates because these drugs can remain within bone for years after discontinuing them stop (21, 22) in case treatments are planned and patients must notify the dental staff of their intake of these medications. Also, notifying patients of the benefits and the risk of the occurrence of BRONJ before bisphosphonate treatment is necessary; patients must let their doctor know about swelling, pain, the existence of exposed bone and efforts to maintain oral hygiene (11, 13).

This study analysed actual conditions regarding systemic medical history examinations and awareness of BRONJ in dental hygienist because consultation with a physician is necessary for the prevention of BRONJ in patients who have the possibility of drug -related necrosis of jaw. Park *et al.* (14). reported that only 15% of dentists asked a patient about taking bisphosphonates, but our study results show that 46.1% ask about related medicine intake. Thus, dental hygienists must realize the importance of the examination by interview in the prevention and low risk of occurrence of BRONJ, and education is needed for them because their role is important in systemic medical history taking.

This study showed that 79.7% of the respondents said they knew of BRONJ, but 20.3% said they had not heard of it. Park *et al.* (14). reported that 69.8% of the respondents knew nothing of BRONJ or that it did not have a familiar ring about it, and 71.1% of the respondents did not know of the possibility of BRONJ being triggered during invasive treatments in bisphosphonate takers. Thus, there is an urgent need for training/education and knowledge delivery. In the results, 55.3% of the respondents had received some education about BRONJ, 33.77% of them at their work places, but only 19.4% of dental hygienist working in dental clinics answered that they had received education. So, there is a big difference in education experience according to working place type. There was a statistically significant difference in education experience and among dental clinics, university hospitals and dental hospitals ($P < 0.05$).

At the larger institutions, there was more recognition and education, but there was no difference in degree of understanding according to age, work experience or work place. The degree of understanding about BRONJ was still very low in dental hygienists, on average 6.14 points, like the results of Park *et al.* (14). Therefore, professional and organized education is needed to improvement knowledge about BRONJ in all dental hygienists.

Because this study used a self-reported questionnaire, the responses may have been limited by the accuracy of the respondent's understanding of the question. Additionally, a usage survey and interview data addressing the limitations of this study, taking into account local characteristics and the number of samples needed for comparisons are needed in future research, because this study was limited to dental hygienist working in dental institutions located in Seoul.

Within the limitation of this study, the dental hygienists working at university and general hospitals have more opportunity to receive training regarding on BRONJ than those working in dental clinics. Thus, the development of professional training programs about BRONJ for all dental hygienists is considered essential.

## Clinical relevance

We studied awareness in dental hygienists of increasing bisphosphonate-related osteonecrosis of the jaw (BRONJ) in patients with osteoporosis or cancer and assessed the situation in systemic history investigations to broaden the scope of their BRONJ awareness as a basis for contributing to preventing this disease.

Most of dental hygienists had some awareness of BRONJ. Age, work experience and institution types were not related to the degree of understanding. And their working institution type is related to receive opportunity of progressive training.

Thus, it is considered that the development of professional training programs about BRONJ for all dental hygienists is necessary.

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## Authors contributions

Yon-Joo Mah, DDS, PhD, contributed data analysis and interpretation, manuscript writing and revising critically. Gyeong-Yeon Kang, MDH contributed conception and design, collection and assembly of data, data analysis and interpretation and drafting the article. Sun-Jong Kim, DDS, PhD, contributed conception and design, and final approval of manuscript.

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