Association between Radiographic Severity of Osteoarthritis of Finger Joints and Bone Mineral Density

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Objective: To determine whether or not there is a correlation between the severity of hand osteoarthritis (OA) and low bone mineral density (BMD).

Materials: In 30 patients with hand OA who attended our department with chief complaint of arthralgia in the fingers, data on BMD and the radiographic severity of hand OA were statistically analyzed. Of the 30 subjects studied, 24 were females and 6 males. All subjects aged between 49 and 85 years (mean: 70.0 years). They consisted of 18 subjects with Heberden's nodes, 8 with Bouchard's nodes, and 9 with rhizarthrosis.

Methods: Radiographic severity of hand OA was scored with the Kellgren/Lawrence scale (grade 0–4). BMD of vertebral bodies was measured by dual-energy X-ray absorptiometry.

Results: A statistically significant correlation was found between the radiographic severity of Heberden's nodes and low BMD, whereas neither rhizarthrosis nor Bouchard's nodes showed any correlation between radiographic severity and BMD.

Conclusions: A statistically significant correlation between the radiographic severity of hand OA and BMD was established solely for Heberden's nodes. Although low BMD may influence the progression of hand OA, there may also be other influencing factors.

Key words: hand osteoarthritis, bone mineral density, Heberden's nodes, Bouchard's nodes, rhizarthrosis

Introduction

Heberden's nodes, Bouchard's nodes, and rhizarthrosis are well known features of osteoarthritis (OA), which is linked to aging and, when occurring in hands, associated with finger pain and dysfunction^{1,2)}. Reported risk factors for hand OA include increasing age over 50, female sex, obesity, mechanical forces, and family history¹⁾. OA, a disease of the locomotor system that tends to increase in prevalence with aging and to worsen every year after onset, serves as a predisposing factor for fractures, causing every kind of locomotor dysfunction^{3,4)}. Furthermore, female sex is a well-

known risk factor for osteoporosis. Thus, osteoporosis and hand OA have common factors. Nevertheless, whether the disease osteoporosis is closely linked with the onset of hand OA is not clear because there are two opposing theses on this theme. In addition, it also remains to be established whether there is a correlation between the progression of hand OA and severity of osteoporosis. The present study was conducted to determine whether or not there is an association between the severity of hand OA and low bone mineral density (BMD).

Materials and methods

The subjects of this study were 30 patients with

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Table-1 Background characteristics of subjects

Height (cm)	142-185	(mean: 157.4)
Body weight (kg)	33.5-84	(mean: 54.6)
BMI (kg/m ²)	13.3-29.9	(mean: 21.9)
BMD (g/cm ²)	0.81-1.42	(mean: 1.00)
VAS (mm)	3-84	(mean: 44.8)
Grip strength (kg) Left	2-26	(mean: 14.6)
Right	5-39	(mean: 16.1)
Dominant hand (number of subjects)	Left, 3; right, 27	
Occupation (number of subjects)	Unemployed, 26	
	Employed, 4 (sushi chef, 1; owner of buckwheat-noodle shop, 1; barber, 1; clerk, 1)

Figure-1 Distribution of K/L grades in subjects with Heberden's nodes **Figure-2** Distribution of K/L grades in subjects with Bouchard's nodes

hand OA who attended our department between April and December 2013 with chief complaint of arthralgia in the fingers. Of these subjects, 24 were females and 6 males. Their ages ranged from 49 to

85 years, with a mean of 70.0 years. Table-1 shows their background characteristics. The subjects consisted of 18 with Heberden's nodes, 8 with Bouchard's nodes, and 9 with rhizarthrosis. Of the

Figure-3 Distribution of K/L grades in subjects with rhizarthrosis

Table-2 Correlation between radiographic severity (mean) scored with K/L scale and BMD (adjusted for age and BMI)

	Correlation, <i>r</i>	Significance probability, <i>P</i>
BMD: Heberden's nodes scored with K/L scale	-0.38	0.048
BMD: Bouchard's nodes scored with K/L scale	-0.05	0.809
BMD: rhizarthrosis scored with K/L scale	0.09	0.658

(*p* < 0.05)

Table-3 Correlation between radiographic severity (mean) scored with K/L scale and VAS or grip strength

	Correlation, <i>r</i>	Significance probability, <i>P</i>
VAS value: Heberden's nodes scored with K/L scale	0.18	0.356
VAS value: Bouchard's nodes scored with K/L scale	0.07	0.729
VAS value: rhizarthrosis scored with K/L scale	-0.18	0.354
Grip strength: Heberden's nodes scored with K/L scale	-0.18	0.353
Grip strength: Bouchard's nodes scored with K/L scale	0.12	0.543
Grip strength: rhizarthrosis scored with K/L scale	0.13	0.523

(*p* < 0.05)

total, 2 with rhizarthrosis underwent arthrodesis and the others received conservative therapy such as orthotic therapy. The duration of pain ranged from several weeks to 10 years, with a mean of 17.4 months. The radiographic severity of hand OA was scored with the Kellgren/Lawrence (K/L) scale (grade 0-4)⁵⁾. BMD of vertebral bodies was measured by dual-energy X-ray absorptiometry

(DEXA) to evaluate total-body BMD. Furthermore, grip strength and pain were graded with a visual analogue scale (VAS), and their correlation with the severity of hand OA was evaluated. The mean K/L grade for hand OA, BMD adjusted age, and body mass index (BMI) were statistically analyzed with Spearman's rank correlation coefficient. The level of statistical significance was set at *p* < 0.05.

Results

Figure-1 shows the distribution of K/L grades for Heberden's nodes. As is apparent from this graph, K/L grade ranged from 0 to 4, and a grade of 2 tended to predominate in this form of hand OA (Figure-1). For Bouchard's nodes, K/L grade showed the following distribution: grades 0 and 1-i.e., less severe OA-accounted for about 70-80% of the total, and few subjects had grades 3 and 4-more severe OA (Figure-2). The same was almost true in the case of rhizarthrosis, i.e., grades of 0 and 1 accounted for about 60-70% of the total, and few subjects had grades 3 and 4 (Figure-3).

According to the results of our statistical analyses, K/L grading and BMD data showed that the severity of Heberden's nodes tended to increase with a decrease in BMD, with significance of *p* < 0.05 (Table-2). Other joints showed no correlation between the severity scored with the K/L scale and BMD. VAS showed no correlation with BMD regardless of the joint studied. Grip strength also showed no correlation with K/L grade regardless of the joint studied (Table-3).

Cases are presented below.

Discussion

The results of our study revealed a distinct positive correlation between low lumbar BMD and the radiographically demonstrated degree of progression of Heberden's nodes. This finding indicates that low BMD also plays a small part in the exacerbation of OA, although other unknown contributing factors are considered to be highly responsible for such exacerbation. In contrast, there was no correlation between low lumbar BMD and the progression of rhizarthrosis or Bouchard's nodes. This finding indicates that, whereas other unknown contributing factors are highly responsible for exacerbation of these forms of hand OA, low

BMD is not very responsible. As has been described, low BMD was associated with exacerbation of Heberden's nodes, but not the progression of Bouchard's nodes or rhizarthrosis. With respect to this finding, attention should be given to the fact that, in general, Heberden's nodes have a significantly higher prevalence than the other two forms of OA. No further details about this are clear, however.

In 2008, Tsuchiya *et al.* determined the prevalence of hand OA in 35 patients at the initial and follow-up assessments to detect a change in BMD. Assessment of hand OA was carried out in frontal plain X-rays of the left hand used for BMD measurement (made in accordance with the DXR imaging protocol [DIP]). Patients with K/L grade of 2 or higher were regarded as having hand OA. The 35 patients were classified according to prevalence of hand OA into two groups—increased and unchanged—and an intergroup difference in the change in BMD was then examined. They reported that no correlation with BMD was found⁶⁾. On the other hand, in 2006, Zoli reported that postmenopausal women with erosive osteoarthritis (EOA) of the hand had a significantly higher prevalence of osteoporosis of the lumbar spine compared with postmenopausal women without hand EOA and controls⁷⁾. According to Zoli's findings, the onset of osteoporosis of the lumbar spine was correlated with that of hand OA. Furthermore, the results of our present study newly suggested a correlation between the progression of osteoporosis of the lumbar spine and that of some forms of hand OA. Nevertheless, there are reports of opposing findings. No definite conclusion has therefore been reached concerning the correlation between the progression of hand OA and low BMD, regardless of its onset or progression.

In regard to osteoporosis and OA of the knee joint as a weight-bearing joint, the following two findings have been reported regarding their onset and progression. In 2004, Isbagio reported that there were no significant difference in total bone mineral content between subgroups of knee OA grades⁸⁾. On the other hand, in 2014, Im reported that low BMD of the lumbar spine was associated with a lower incidence of knee OA⁹⁾. These views are not in accord. There is no report that low BMD is associated with exacerbation of OA, however.

What is the major cause of exacerbation and progression of hand OA? One of the possibilities is considered to lie in the repetitive involvement of minute injuries of the articular cartilage. In 1989, Bergenudd reported that women with Heberden's nodes had more physically demanding jobs¹⁰⁾. Clinical studies of the knee (as a weight bearing joint) show that, whereas a higher incidence of knee OA is observed in an exercise environment in which sudden acceleration, quick stops, and abrupt changes of direction are required, as in soccer¹¹⁾, no increase in the incidence of OA is seen in any environment in which joints are exposed to monotonous repetitive axial loading, as in a long-distance race runner¹²⁾. These findings suggest the notion that repetitive application of injurious forces to articular surfaces may cause repeated minute cartilage injuries, thereby eventually leading to OA.

From the viewpoint of treatment, on the other hand, the association between knee OA and BMD has been reported by Alekseeva in 2013 as follows: therapy with ibandronic acid, a drug for treatment of osteoporosis, resulted in a significant reduction in pain, knee joint stiffness, and locomotor functional failure in patients with gonarthrosis¹³⁾. If any drug for treatment of osteoporosis is effective in producing an improvement in symptoms, it may hold promise for the symptomatic improvement of hand OA as well.

In any case, further studies in a greater number of subjects through various approaches may be needed to clarify the mechanism of hand OA progression, as well as to establish the correlation between progressive worsening of hand OA and exacerbation of osteoporosis. Low BMD has been known to lower the quality of the subchondral bone¹⁴⁾. Therefore, an OA drug that provides evidence to show usefulness in improving the quality of the subchondral bone is expected to become available in the future and applicable in the treatment of OA.

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