Osteonecrosis of the mandibular condyle as a precursor to osteoarthrosis: A case report

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Osteonecrosis of the mandibular condyle is a rare condition characterized by a primary subchondral osseous breakdown of the condyle with secondary articular surface collapse. Despite these characteristics, it has proved to be difficult to diagnose. The present case of osteonecrosis of the mandibular condyle was initially diagnosed more than 2 years before. The diagnosis at that time was based on physical examination, plain film radiography, cone-beam computerized tomography, magnetic resonance imaging, and total body scintigraphy. The disease had progressed into severe osteoarthrosis at a 2-year follow-up using cone-beam computerized tomography. This report suggests that osteonecrosis may be a precursor of osteoarthrosis, and cone-beam computerized tomography may provide a sensitive radiographic technique for the diagnosis of osteonecrosis of mandibular condyle. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;107:e34-e38)**

Osteonecrosis has also been called avascular necrosis (AVN), ischemic necrosis, and aseptic necrosis. It was defined as necrosis of epiphysial or subarticular bone secondary to a diminished or disrupted blood supply in the absence of infection.[1] Most cases of AVN have been found to involve the femoral head and the hip joint. Less common sites are the head of humerus, patella, and lower thoracic vertebrae.[2] The temporomandibular joint (TMJ) has been rarely affected by the disease.[3-9]

It has been difficult to make an early diagnosis of AVN of the mandibular condyle.[4] Depending on the stage of the lesion, plain radiographs may appear completely normal or may be misinterpreted as osteoarthrosis. There are few reports of specific radiographic findings of AVN associated with the mandibular condyle, such as the crescent sign or double-line sign found in osteonecrosis of the hip.[4] However, with the use of advanced imaging techniques, AVN of the TMJ may be found to be more common than generally recognized or reported.[5,10] Magnetic resonance imaging (MRI) has been established as a technique for the diagnosis of early AVN. Focal, subarticular, and/or generalized condylar lesions with decreased first-echo marrow signal and either decreased, variable, or increased T2 signal, with or without morphologic alterations, were considered to be suspicious for AVN.[5] Based on MRI findings, AVN has been shown to affect the mandibular condyle.[5,6,8,9,11,12] However, the most reliable MRI signal pattern for AVN was a combination of both edema and sclerosis, giving an appearance of the characteristic "double-line" sign not often found in the mandibular condyle.[6]

Avascular necrosis may lead to severe pain along with the development of bone fragility, collapse of the articular surface, and degenerative changes of the TMJ in later stages. When articular surface collapse occurs, differentiation from advanced osteoarthrosis may not be possible. The present paper reports a case of probable osteonecrosis of the mandibular condyle, including description of the features demonstrated by conventional radiography, cone-beam computerized tomography (CBCT), and MRI with radionuclide imaging. The early findings of osteonecrosis of the mandibular condyle and later progression into severe osteoarthrosis at 2-year follow-up were clearly presented using CBCT. The etiology of AVN and CBCT possibly being a sensitive radiographic technique for early diagnosis of osteonecrosis of mandibular condyle are discussed.

CASE REPORT

A 68-year-old woman presented to the Center for Temporomandibular Disorders and Orofacial Pain in June 2006,

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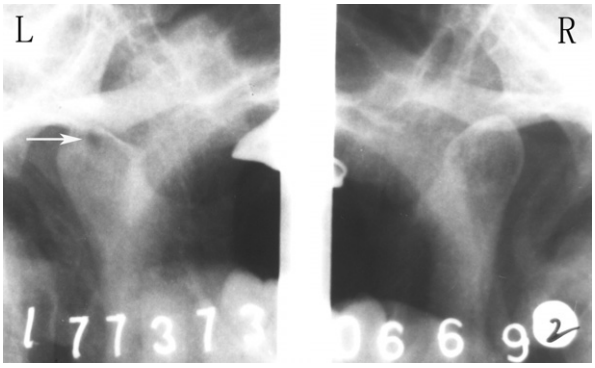

Fig. 1. Transpharyngeal radiograph. A subcortical radiolucent lesion (*arrow*) was found to be located within the left condyle.

complaining of pain in her left TMJ. She described the pain as a mild aching pain that was aggravated by jaw movement. Her maximum mouth opening was 40 mm. Jaw opening was associated with crepitus on condylar translation. Points of mild tenderness on palpation were found in the areas of both the left temporal and the masseter muscles. Moderate tenderness was found in the left joint area. The head and neck examination revealed no evidence of adenopathy, paresthesia, or motor nerve deficiency. The patient's general medical history was unremarkable except for osteoporosis and an arthroscopic surgery 7 years previously due to primary knee osteoarthrosis. She did not have a history of trauma, previous TMJ surgery, or previous steroid injection into the TMJ. She had physical examinations on an annual basis, and there was no reported history of malignant disease.

A transpharyngeal radiograph showed a small radiolucent lesion associated with the left condyle (Fig. 1). The finding of the radiolucent lesion led us to suspect a bone disease, and the patient was asked to take CBCT (3DX Multi Image micro CT; J. Morita Mfg. Corp., Kyoto, Japan). After scanning the TMJ, serial images (1 mm thick) of the condyle were sagittally and coronally reconstructed. We selected 4 coronal images (1.5 mm gap) from posterior section to anterior section, e.g. Fig. 2, *A-D*, and printed them out. Cone-beam CT has been used for years, and the images can clearly reveal the bony margin of the articular surface and the subchondral cancellous trabecular structure. Coronal views in the case demonstrated cyst-like radiolucent lesions, within cancellous bone and discontinuity of the superior cortical margin (Fig. 2, *A-D*). An MRI study (1.5 Tesla; Siemens Sonata) was then performed: Proton density (TR 3490 ms, TE 17 ms)– and T2 (TR 3490 ms, TE 135 ms)–weighted images (3 mm thick,16 cm field of view images) were formatted in oblique sagittal planes in both the closed- and the open-mouth positions. A diagnosis of anterior disc displacement without reduction associated with the left TMJ was made (Fig. 3, *A* and *B*). The right side showed no displacement of the disc (Fig. 3, *C* and *D*). Proton density–weighted images showed low signal intensity in most of the left condyle marrow (Fig. 3, *A* and *B*), compared with homogeneously high signal on the right side (Fig. 3, *C* and *D*). The focal subchondral region showed intermediate signal intensity on proton density–weighted and high signal on T2-weighted images mixed with or surrounded by a low signal band, an appearance of osteonecrosis (Fig. 3, *A*, *B*, and *E*).[5,6] The next section of the left condyle exhibited a localized and significantly high signal in the subchondral bone marrow on the T2-weighted image (Fig. 3, *F*). Total body scintigraphy revealed an increased uptake of radionuclide in the left condyle (Fig. 4). This corresponded to the site of the lesions seen on CBCT and MRI. No pathologic uptake of the radionuclide was found in other parts of the body.

Based on all of the information obtained and MRI diagnostic criteria described by Schellhas et al,[5] a diagnosis of osteonecrosis of the left mandibular condyle was made. The patient was prescribed nonsteroidal antiinflammatory drugs and glucosamine sulfate for joint pain control and treatment, and was asked to return regularly for evaluation. Almost 1 year later (April 2007) the second CBCT showed that destructive changes of the condyle had progressed. The articular surface had collapsed, but the cyst-like lesions were not enlarged (Fig. 2, *E-H*). The glenoid fossa was found to have the same radiographic alterations (Fig. 2, *E-H*). Since early 2007, the patient had received calcitonin injections and oral calcitriol for the treatment of osteoporosis. In April 2008, the patient reported that her situation had improved, joint pain was decreased, and oral mandibular function was normal. The third CBCT made at that time revealed severe osteoarthritic appearance of the condyle (Fig. 2, *I-L*). However, evidence of repair was noted. The bony defects of the condyle had become smaller, a new cortical articular surface appeared to have formed, and the density of the subchondral bone had increased (Fig. 2, *I-L*). Unfortunately, a new lesion appeared to have developed on the medial portion of the condyle (Fig. 2, *J-L*).

DISCUSSION

The etiology of AVN is currently unknown. It is thought to be the result of ischemia that in turn may be related to direct blood vessel injury (post-traumatic necrosis), intraluminal obliteration (vasculopathy), or extraluminal obliteration in the bone marrow.[13] AVN has been reported to rarely affect the mandibular condyle and was considered to be unlikely owing to the vigorous blood supply to the mandibular ramus and condyle.[4] However, with the application of advanced diagnostic techniques, it has been learned that the disease might be a relatively common disorder that was generally not recognized.[5,10] These suggestions have been based on alterations of MR signal from the mandibular condyle similar to those seen in the femoral head with osteonecrosis.[5,6,8,9,11,12] These studies on TMJ have focused on bone marrow alterations (edema, osteonecrosis) in the mandibular condyle and investigated the relationships among age, joint pain, effusion, and bone marrow alterations. Most of them stated that bone marrow edema is closely related to internal derangement, osteoarthrosis and effusion.[5,6,11,12] They

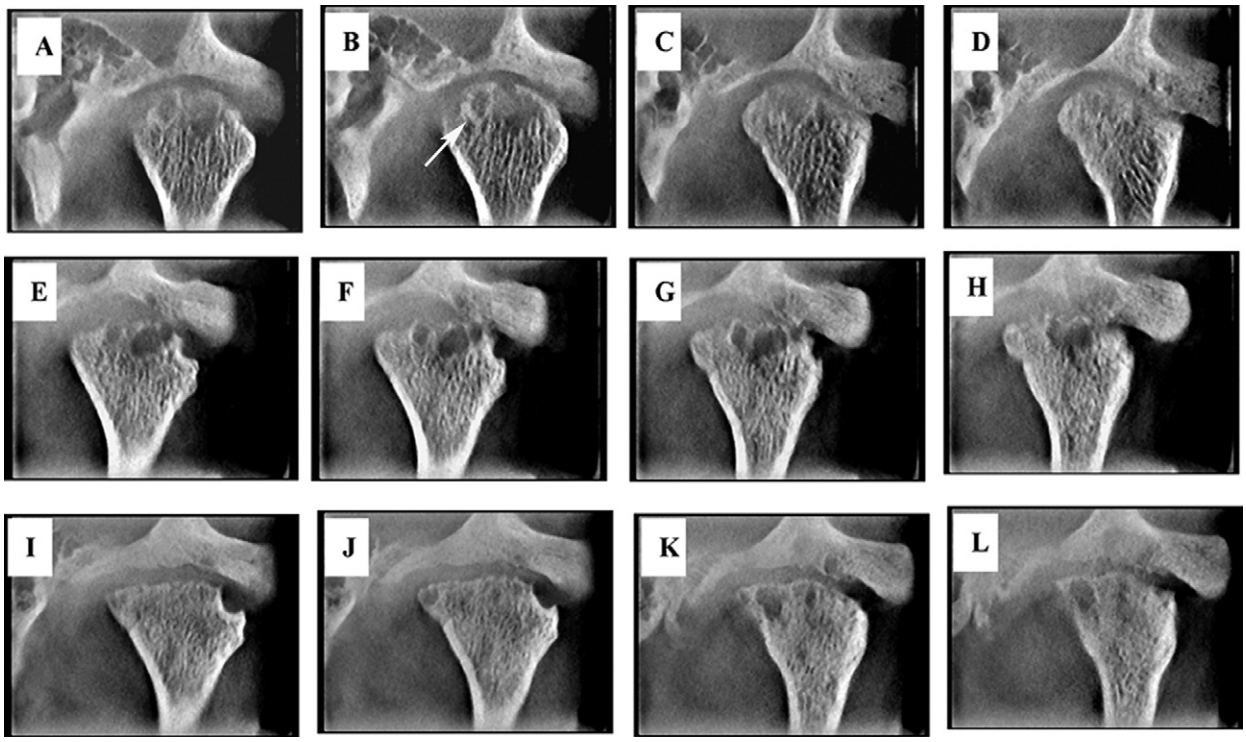

Fig. 2. Cone-beam computerized tomography (CBCT) images of the left condyle. **A-D,** The first CBCT was in June 2006 and showed 2 cyst-like radiolucent lesions with the discontinuance of the articular surface, 1 cyst surrounded by a sclerostic rim (**B**, *arrow*); **E-H**, The second CBCT in April 2007 showed the articular surface collapsed and loss of vertical dimension in the condylar head, the opposing glenoid fossa having the same osteoarthritic changes. **I-L,** The third time CBCT in April 2008 showed the appearance of severe osteoarthrosis; the condyle was obviously deformed and had lost vertical dimension, but a new cortical articular surface appeared to have formed and the density of the subchondral bone had increased, indicating a repair process.

also reported that edema may be a precursor for osteonecrosis in the mandibular condyle, and was more common in anterior disc displacement (ADD) without reduction than in ADD with reduction.[5,12] It was suggested that the anteromedially displaced disc may mechanically compromise extraosseous arterial and venous flow by compression of the lateral pterygoid muscle where it inserts into the mandibular condyle.[14] In the present case, the disc was anteriorly displaced without reduction on the affected left side and was normal on the unaffected right side. This finding is consistent with the suggestion that internal derangement might be a risk factor of AVN in the mandibular condyle.

Osteoarthrosis of TMJ is a common, primarily noninflammatory, joint disease characterized by a deterioration of the articular surfaces and simultaneous remodeling of the underlying bone.[15] Radiographically, it presents as surface irregularities, flattening, sclerosis, and exophyte formation. Changes are considered to be severe when the condyle is deformed and has lost vertical dimension.[15,16] With AVN, the articular surface of the condyle loses its structural integrity and is subjected to mechanical stress. This may lead to loss of vertical dimension and the development of osteoarthrosis, as reported here. In the present case, initially we found focal subchondral radiolucencies in the CBCT images which looked like subchondral cysts; 1 cyst was surrounded by a sclerotic rim (Fig. 2, *B*). The lesion should be developed primarily from the cancellous bone, because the articular surface was less affected (Fig. 2, *B*). On the other hand, subchondral cyst-like change is a rare finding in osteoarthrosis, but it is one of the histologic criteria for osteonecrosis.[4] The MRI findings and radionuclide imaging further supported the initial diagnosis of osteonecrosis (a disease involving the bone marrow), although we could not confirm by histopathology. One year later, CBCT (Fig. 2, *E-H*) showed that destructive changes of the condyle had progressed and the articular surface had collapsed. The opposite fossa was also found to have the same radiographic alterations (Fig. 2, *E-H*), which was not found in the first CBCT images (Fig. 2, *A-D*). The same situation was fully discussed by Chuong et al.,[4] that

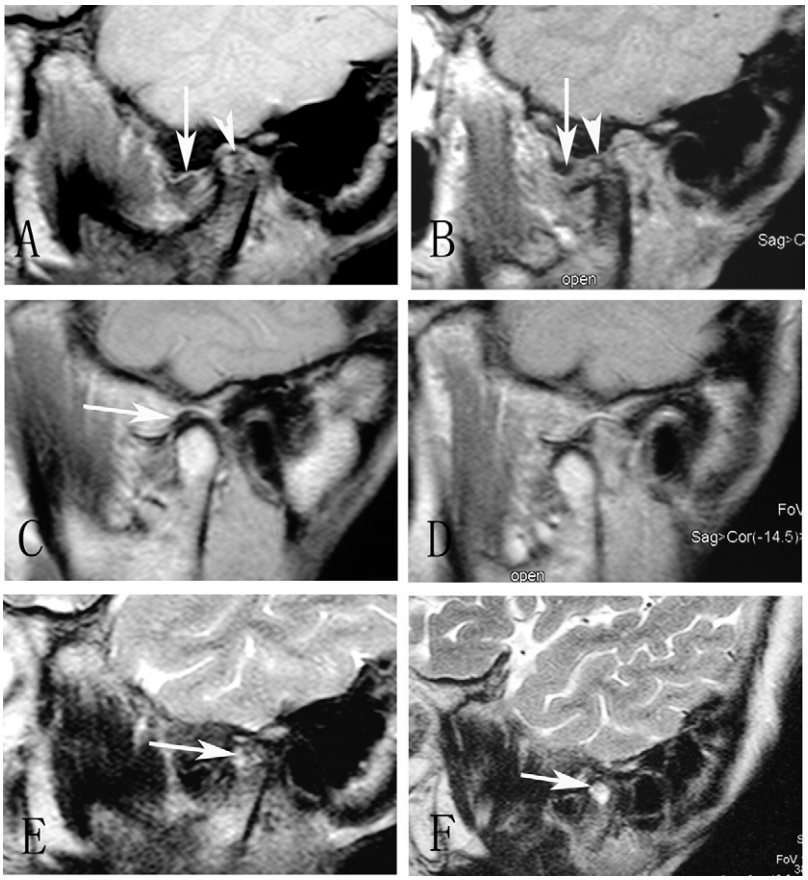

Fig. 3. **A,** proton density weighted image in the closed-mouth position revealed anterior disc displacement (*arrow*) in the left side, and the subchondral region showed intermediate signal intensity mixed with a low-signal band (*arrowhead*). **B,** The displaced disc (*arrow*) was not reduced on the open-mouth position, and the subchondral region showed intermediate signal intensity surrounded by a low-signal band (*arrowhead*). **C, D,** Proton density–weighted image from the right side showing the normal disc position (*arrow*) and the condylar contour, in both the closed (**C**) and open (**D**) mouth positions. **E, F,** T2-weighted images of the left condyle, showing the focal subchondral high signal mixed with a low-signal band (**E**, *arrow*), and a significantly high signal of the bone marrow lesion (**F**, *arrow*).

osteonecrosis was a primary subchondral osseous breakdown of the condyle with secondary articular surface collapse and without initial involvement of the opposing fossa. The fossa changes of such secondary osteoarthrosis occur as a result of mechanical trauma caused by incongruity of the articular surfaces.[17] The subsequent appearance of degenerative changes in the fossa in the case led to the diagnosis of secondary osteoarthrosis arising after osteonecrosis. The radiographic changes of the follow-up CBCT suggests that osteonecrosis may be a precursor of osteoarthrosis.

Early diagnosis of AVN has been difficult. Both MRI and nuclear bone scan may show early changes of osteonecrosis but are not sufficiently specific. Osteonecrosis is a primary bone problem that results in radiographic sclerosis and lucency, and then in collapse of the articular surface, causing the loss of its normal contour. Using CBCT the cortical margin of the articular surface and the subchondral cancellous trabecular structure should be clearly shown. In the present case, coronal CBCT images demonstrated small radiolucent lesions with a sclerotic rim before the articular surface collapsed, suggesting that CBCT may provide a sensitive radiographic technique for the diagnosis of AVN.

In summary, osteonecrosis can affect the mandibular condyle. This condition may be detected early by CBCT. In the late stage of osteonecrosis, differentiation from severe osteoarthrosis may not be possible.

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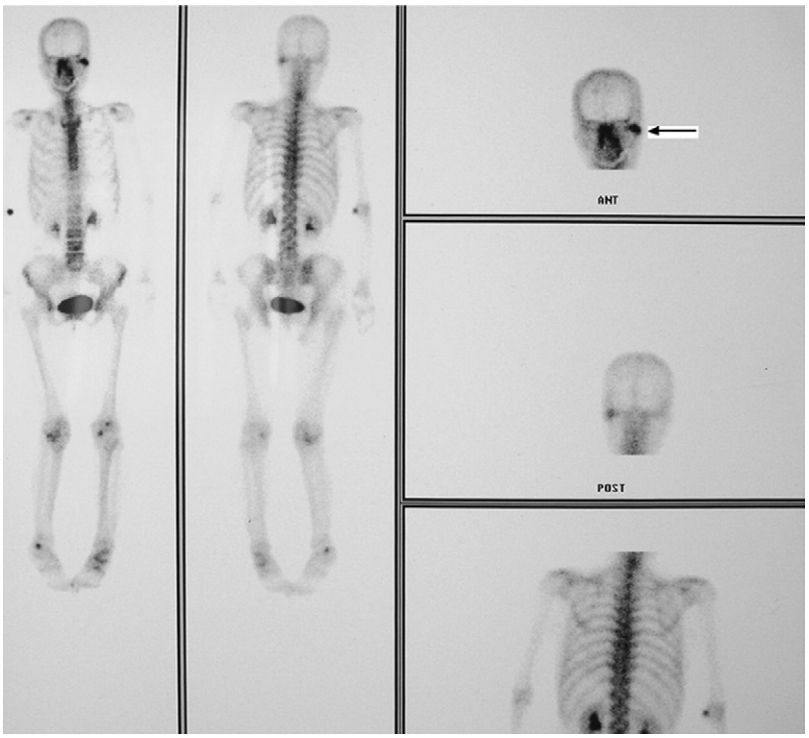

Fig. 4. Total-body nuclear bone scan revealed an increased uptake of radionuclide in the left condyle (*arrow*).

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