osteal new bone formation were all noted. Osteosclerosis of the alveolar process was found in all radiographs. In the mandible, this sclerosis was especially distinct and noted to be located only above the inferior alveolar canal. Rarely were all radiographic features visualized in a single case. Another important finding was the presence of periodontal disease in all 29 of the cases that involved the jaws. This could be attributed to the fact that BP accumulates preferentially in sites of high bone turnover or remodeling.

Conclusions. Recognition of the radiographic features plays a crucial role in the early detection of osteonecrosis and treatment planning of patients on oral BP. In early stages, oral radiographic findings may be the only indicator of BONJ and can precede the finding of exposed bone.


Bisphosphonates are synthetic analogues of naturally occurring pyrophosphate, capable of binding hydroxyapatite of bone and inhibiting osteoclast-mediated bone resorption. This property has led to their use in cancers well known to metastasize to bone, most notably breast and prostate cancer. We show here that zoledronic acid (ZA) directly induces apoptosis, in a survivin-dependent manner, to a significantly greater degree in tumorigenic than in nontumorigenic primary tumors. Nontumorigenic (MCF 10A, LNCaP, respectively) and tumorigenic (MCF 7, PC3, respectively) human breast and prostate cell lines were exposed to different concentrations of ZA (0-10 μM/μL), using 11/4M as the baseline. A dose-response effect on apoptosis and cell proliferation (microscopic observation with annexin V and MTS, respectively) was observed with increasing ZA concentrations to a greater extent in the tumorigenic versus nontumorigenic cells. Gene expression analysis demonstrated the differential expression of multiple genes involved in apoptosis, including tumor necrosis factor, BCL-2, caspase, IAP, TRAF, and death domain families. Western blot analysis confirmed that antiapoptotic proteins survivin, BCL-2, and BCL-XL were down-regulated and that proapoptotic proteins caspase-2, −3, and −9 were up-regulated in the MCF-7 and PC 3 cell lines but remained unchanged in the MCF-10A and LNCaP cell lines, explaining, at least in part, the significantly increased levels of apoptosis within the tumorigenic cells compared with the nontumorigenic cells. The combined results from this study demonstrate that low concentrations of ZA rapidly and directly affect the metastatic lesions through the induction of a gene-regulated apoptotic process. These findings support the potential of ZA to directly affect the tumor, as well as to prevent bony invasion.


The true incidence, etiology, and risk factors that contribute to bisphosphonate (BP)-related osteonecrosis of the jaw (BRONJ) pathogenesis are not known. We conducted a retrospective study to evaluate the frequency, risk factors, clinical presentation, and management of BRONJ in cancer patients treated with intravenous BPs at the University of Minnesota Masonic Cancer Center and Park Nicollet Institute. Eighteen of 576 eligible patients (3.1%) developed BRONJ, including 8 (4.2%) of 190 patients with breast cancer and 6 (7.2%) of 83 patients with multiple myeloma. Ten of the 18 BRONJ patients (59%) developed it after tooth extraction, and 7 (41%) developed it spontaneously. The mean infusions and duration of BP treatment were significantly higher in BRONJ patients compared with control subjects (P < .001). Multivariate Cox proportional hazards regression analysis revealed that diabetes (hazard ratio [HR] 3.40, 95% confidence interval [CI] 1.11-10.11; P = .028), hypothyroidism (HR 3.59, 95% CI 1.31-9.83; P = .013), smoking (HR 3.44, 95% CI 1.28-9.26; P = .015), and higher number of zoledronate infusions (HR 1.07, 95% CI = 1.03-1.11; P = .001) significantly increased the risk of developing BRONJ. Based on the American Academy of Oral and Maxillofacial Surgeons staging system, 1 patient was initially diagnosed with a stage I lesion, 10 with stage II, and 4 with stage III lesions. Initial management of BRONJ was nonsurgical, with debridement performed at subsequent visits if needed. BRONJ lesions healed completely in 2 patients (11%), healed partially in 5 (28%), remained stable in 5 (28%), and progressed in 6 (33%). Increased cumulative doses and long-term intravenous BP treatment is the most important risk factor for BRONJ development. Type of BP, diabetes, hypothyroidism, smoking, and prior dental extractions may play a role in BRONJ development.


Metastasizing mixed tumors are very rare salivary gland neoplasms that are histologically benign but clinically malignant as they metastasize to distant sites. The parotid gland is by far the most common location of the primary tumor, and the most common sites of metastasis reported in the literature include bone, lung, and lymph nodes. We report an interesting case of metastasizing mixed tumor in a 36-year-old man who presented with a mass in the left maxillary buccal gingiva and alveolar mucosa in the area of teeth #13 and #14 21 years after removal of a pleomorphic adenoma from the left parotid gland. Imaging studies showed that the lesion also involved the alveolar bone. Histologic examination revealed a benign salivary gland neoplasm that was consistent with pleomorphic adenoma. Review of the medical history revealed that the patient had 2 recurrences of the primary tumor and 5 metastatic presentations before the current lesion. The patient’s current and past clinical and histologic presentations and work-ups are discussed, along with pertinent review of the literature. As far as we know, this is one of few reports of metastasizing mixed tumor with an intraoral presentation of the metastasis.


Intraosseous mucoepidermoid carcinomas of the jaws are rare, comprising 2%-4% of all mucoepidermoid carcinomas. A review of the English-language literature revealed a paucity of publications detailing the radiographic features of intraosseous