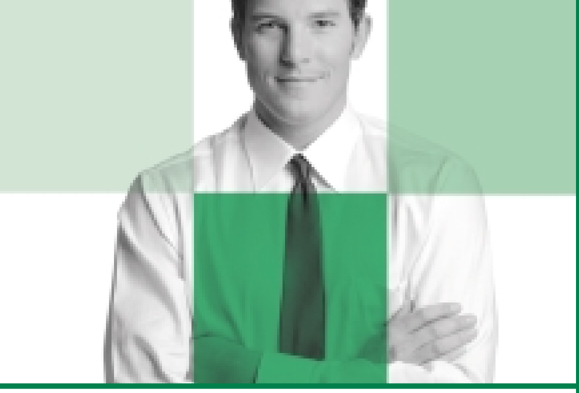


PANORAMIC *Imaging* News

Volume 4, Issue 3 US $6.00

Editor:

Allan G. Farman, BDS, PhD (odont.), DSc (odont.), Diplomate of the American Board of Oral and Maxillofacial Radiology, Professor of Radiology and Imaging Sciences, Department of Surgical and Hospital Dentistry, The University of Louisville School of Dentistry, Louisville, KY.

Contributor:

Dr. C.J. Nortjé, BChD, PhD, DSc, Professor of Oral and Maxillofacial Radiology, The University of the Western Cape, South Africa, President of the International Association of DentoMaxilloFacial Radiology.

Learning Objectives:

Learn through examples how to review panoramic radiographs to screen for early detection of systemic diseases.

Learn how to observe and detect features of systemic diseases when they produce changes in panoramic radiographs.

Understand the limitations of panoramic radiography in detecting systemic diseases.

Provided as a professional service by:

Panoramic Corporation

In conjunction with

The Richmond Institute for Continuing Dental Education

A division of Young Innovations, Inc.

Panoramic Radiographic Detection of Systemic Disease

By Dr. Allan G. Farman in collaboration with Dr. C. J. Nortjé

For the purposes of this report, "systemic disease" will be interpreted as conditions that are spread out within the body rather than localized strictly to the tissues of the oral cavity. Since it would take many volumes to review all such conditions, the intent of this issue of *Panoramic Imaging News* is to review a few examples of conditions where initial panoramic radiographic findings suggested widespread disease of significance enough to affect the quality of life and longevity of the patient. The possibility of detecting carotid calcifications, indicative of cardiovascular disease – the leading cause of death in the US population – was previously addressed in Volume 1, Issue 2 (2001); hence, that topic is not repeated here.

1. Osteoporosis

Osteoporosis results in excessive bone porosity and fragility. It is the most common metabolic disease and presents a major public health problem among the elderly, especially amongst postmenopausal Caucasian and Asian women [1]. It is also found in sedentary or immobilized individuals, and in patients on long-term steroid therapy [2]. The asymptomatic progression of osteoporosis, in conjunction with the possibility of catastrophic disability, makes this disorder a major public health priority [3].

Cardinal radiographic features of osteoporosis in the skeleton as a whole include generalized osteopenia that is often most prominent in the spine, thinning and accentuation of the bone cortices, and accentuation of primary and loss of secondary trabeculation. Ancillary radiologic features include spontaneous, atraumatic fracture, especially of the spine, wrist, hip or ribs, basilar invagination in the skull and granular appearance of bone in the skull [2]. Osteoporosis can lead to pain, especially in the lower back. It can also result in pathologic fracture, loss of physical stature, and severe kyphosis.

Radiologic features of osteoporosis in the jaws (Fig. 1) include relative radiolucency of both jaws and reduced definition of the cortices. The accuracy with which panoramic radiographs can be used to assess the likelihood of a person having osteoporosis is still in debate, with evidence being divided, rather than polarized for or against.

Fig. 1: Osteoporosis – Cropped panoramic image shows a relative radiolucency of both jaws with reduced definition of the cortices.

1.1. Evidence supporting panoramic radiographs to screen for osteoporosis:

In 1991, Benson *et al*. defined a radiomorphometric index of mandibular cortical bone mass, the panoramic mandibular index (PMI) [4]. Differences in the index in a population of 353 adult subjects, equally divided by sex, age (30 through 79), and racial group (Black, Hispanic, White), were evaluated with respect to side, racial group,

" The researchers concluded that panoramic radiography can be used to assess the likelihood of osteoporosis."

sex, age, and combinations of these variables. Blacks were found to have a greater mean PMI than Hispanics or Whites, who were demographically similar. Age-related changes comparing younger and older age groups within each sex and racial group indicated a significant decrease in mean PMI with increasing age in Black and Hispanic women. The mean PMI in white men increased with advancing age.

A retrospective investigation was carried out to determine the strength of association of spinal bone density and the density of selected mandibular sites as determined from panoramic radiographs [1]. Panoramic films of known low bone density and high bone density in women between the ages of 50 and 75 were evaluated. These radiographs were randomized and then converted to digital images for density analysis. Significant differences were found between the groups at the 95th percentile level. <u>Hence, according to this study, blinded observers should be able to differentiate between persons of high and low bone density using panoramic radiographs.</u>

The relationship between oral signs and osteoporosis was investigated to assess the possibility of using this as an indicator of osteoporosis. Taguchi *et al.* (1995) studied 64 postmenopausal women aged 50 to 70. Osteoporotic signs consisted of thoracic spine fracture as demonstrated on lateral chest radiographs. Oral signs were the number of teeth present, mandibular cortical width, alveolar bone resorption, and the morphologic classification of the inferior cortex on panoramic radiographs. The number of teeth present (N) was highly significantly related to the probability of thoracic spine fracture and was used to derive the probability equation for the presence of thoracic spine fracture: probability value = 1/(1 + e-z), Z = 18.68-0.29 age -0.27N. A probability value > 0.5 suggested the possibility of thoracic spine fracture. It was concluded that this equation combined with <u>panoramic radiographic findings could serve as a simple and useful tool for dentists to assess the possibility of latent osteoporosis [5].</u>

The usefulness of width and morphology of the inferior cortex of the mandible on panoramic radiographs was evaluated in the diagnosis of postmenopausal osteoporosis [6]. The width and morphology of the mandibular inferior cortex on panoramic radiographs were compared with trabecular bone mineral density (TBMD) of the 3rd lumbar vertebrae (L3) measured by dual energy quantitative computed tomography in 29 premenopausal and 95 postmenopausal women. There was a significant negative correlation between the width (Kendall's tau = -0.36, $p < 0.001$) and morphology (Kendall's tau = -0.49, $p < 0.001$) of the mandibular inferior cortex and the L3 TBMD. Regression analysis showed that significant linear relationships were observed between the L3 TBMD and age ($p < 0.001$), cortical width ($p < 0.05$), morphology ($p < 0.05$), controlling body mass index, number of teeth present, and menopausal status ($R^2 = 0.42$). <u>The researchers concluded that panoramic radiography can be used to assess the likelihood of osteoporosis.</u>

The value of clinical and radiographic indices in the diagnosis of patients with low skeletal bone mass was investigated among 135 healthy perimenopausal women, aged 45-55 attending for regular dental treatment [7]. Bone mineral density was measured for the spine and femoral neck, using dual energy X-ray absorptiometry. Each patient's osteoporosis status was calculated according to the WHO criteria for Caucasian women. Each patient received a dental panoramic radiograph, and the width of the inferior mandibular cortex (mental index, (MI)) was measured. The body mass index (BMI) and simple calculated osteoporosis risk estimation (SCORE) indices were calculated. The SCORE index was a significant factor in predicting low bone mass, with the weight of the patient being the only significant constituent factor. MI, BMI and SCORE indices were significantly correlated with skeletal bone density. When the logistic regression model included MI, BMI, and SCORE indices, all three variables were significant predictors of low skeletal bone mass. A thinning of the mandibular cortices (MI < 3 mm) in a normal perimenopausal female was associated with low skeletal bone mass. <u>If, in addition, the patient is underweight (BMI is below 20kg/m^2) or has a high SCORE index (= 6) then this assessed increase in risk was found to be reliable in screening for osteoporosis.</u>

Nakamoto *et al.* (2003) looked into whether untrained general dental practitioners are capable of determining from panoramic radiographs whether women have low bone mineral density (BMD) [8]. The investigators studied observer agreement and diagnostic efficacy in detecting women with low BMD. This was accomplished when 27 GDPs assessed the appearance (normal or eroded) of the mandibular inferior cortex on dental panoramic radiographs of 100 postmenopausal women who had completed BMD assessments of the lumbar spine and of the femoral neck. Intra-and inter-observer agreements were analyzed with kappa statistics. The diagnostic efficacy (sensitivity, specificity, and predictive values) was analyzed by comparing two groups classified by the mandibular inferior cortex (women with normal and women with eroded mandibular inferior cortex) with those classified by BMD (women with normal BMD and women with osteopenia or osteoporosis). The mean sensitivity and specificity were 77% and 40%, respectively, when BMD of the lumbar spine was used as the standard, and 75% and 39%, respectively, when BMD of the femoral neck comprised the standard. Nineteen of the 21 untrained general dental practitioners presented a moderate to almost perfect intra-observer agreement. <u>It was concluded that dental panoramic radiographs might be used in clinical dental practice to identify postmenopausal women who have undetected low BMD.</u>

1.2. Evidence against using panoramic radiographs to screen for osteoporosis:

Mohajery and Brooks (1992) conducted a trial to determine whether radiographic changes could be detected in the mandible of patients with mild-to-moderate postmenopausal osteoporosis and whether these changes could be used as a diagnostic tool to differentiate normal from osteoporotic patients [9]. Subjects were classified as either osteoporotic (n = 21) or normal (n = 14) on the basis of bone density measurements of the lumbar spine and femoral neck, as determined by dual-photon absorptiometry. Mandibular bone density measurements were made on panoramic and periapical radiographs and expressed in terms of millimeters of aluminum equivalent. Thickness of the cortex at the angle of the mandible, sinus floor, and lamina dura of the tooth socket was also measured. There were no significant differences in any of the mandibular measurements between the normal and osteoporotic subjects. Whereas the skeletal bone measurements were correlated with each other, there was no correlation between skeletal and mandibular bone measurements. Women with mild-to-moderate osteoporosis could not be distinguished from women with normal bone density.

The panoramic mandibular index was used in a group of postmenopausal women to determine whether it correlates with bone mineral densities of the femoral neck, lumbar area, and the trabecular and cortical parts of the mandible [10]. Bone mineral density values were measured by dual-energy x-ray absorptiometry of the femoral neck and lumbar area and by quantitative computed tomography of the mandible. Linear correlation of the panoramic mandibular index with all bone mineral density values was weak. However, the low and high index subgroup means were clearly dependent on the bone mineral density variables. The authors concluded that despite significant differences in PMI between osteoporotic subjects and controls, panoramic assessment is not to be advocated as an assessment for osteoporosis.

Watson *et al.* (1995) investigated whether osteoporotic postmenopausal women show a decrease in mandibular cortical bone height, as measured by the PMI index, when compared with nonosteoporotic postmenopausal women [3]. Seventy-two Caucasian females (33 cases/39 controls), age range 54-71 , were selected through records and screening via a dual-energy x-ray absorptiometry scan (LUNAR-DEXA). ANOVA analysis indicated no differences in the mean PMI between case and control groups (0.37 ± 0.15 and 0.38 ± 0.13, respectively; p = 0.69).

1.3. Osteoporosis and periodontal disease:

A study of 227 healthy postmenopausal women aged 48 to 56 years was made to determine whether advanced alveolar bone loss, diagnosed by panoramic radiographs plus periodontal probing depths and the number of remaining teeth were correlated with the bone mineral status of the skeleton and cortical bone in the mandible [11]. The results indicated that individuals with high mineral values in the skeleton retained teeth with deep periodontal pockets more readily than did those exhibiting osteoporosis. Individuals with normal or high bone density seem to be best able to retain teeth despite advanced periodontal disease.

Studies have also suggested that osteoporosis and periodontitis are associated diseases. Persson *et al.* (2002) investigated: (1) the prevalence of self-reported history of osteoporosis in an older, ethnically diverse population; (2) the agreement between panoramic and mandibular cortical index (MCI) findings and self-reported osteoporosis; and (3) the likelihood of having both a self-reported history of osteoporosis and a diagnosis of periodontitis [12]. Panoramic radiographs and medical histories were obtained from 1,084 female Chinese subjects aged 60-75 (mean age 68 ± 5 years). Of the panoramic radiographs, 90% were deemed useful for analysis using MCI. They were used to grade subjects as not having periodontitis or with one of three grades of periodontitis severity. A positive MCI was found in 39% of the subjects, in contrast to 8% self-reported OP. The intra-class correlation between MCI and self-reported osteoporosis was 0.20 ($p < 0.01$). The likelihood of an association between osteoporosis and MCI was 3% (95% CI: 1.6, 4.1, $p < 0.001$). Subjects with self-reported osteoporosis and a positive MCI had worse periodontal conditions ($p < 0.01$). The Mantel-Haentzel odds ratio for osteoporosis and periodontitis was 1.8 (95% CI: 1.2, 2.5, $p < 0.001$). The prevalence of positive MCI was high and consistent with epidemiological studies, but only partly consistent with a self-reported history of osteoporosis with a higher prevalence of positive MCI. Horizontal alveolar bone loss was associated with both positive self-reported osteoporosis and MCI findings.

Contrary findings were made by Lundstrom *et al* (2001) [13]. The authors examined the periodontal conditions in an age cohort of 70-year-old women comparing an osteoporosis group with a control group with normal bone mineral density. 210 women 70 years old were randomly sampled from the population register of the community of Linkoping, Sweden. Bone mineral density (BMD) of the hip was measured by dual energy X-ray absorptiometry. 19 women were diagnosed with osteoporosis (BMD < 0.640 g/cm^2 in total hip) and 15 of them agreed to participate in the study. As a control group 21 women with normal bone mineral density (BMD > 0.881 g/cm^2) were randomly selected from the initial population. The clinical examination included registration of the number of remaining teeth, dental plaque and periodontal conditions. The examination included a dental panoramic radiograph and vertical bitewings. The subjects completed a questionnaire on general health, age at menopause, concurrent medication, smoking and oral hygiene habits. No statistically significant differences in gingival bleeding, probing pocket depths, gingival recession and marginal bone level were found between the women with osteoporosis and those with normal bone mineral density. In conclusion, the study revealed no statistically significant differences in periodontal conditions or marginal bone level between the two groups; however, these results must be interpreted with caution since the compared groups were small.

2. Diabetes Mellitus

Diabetes mellitus is a common disorder of carbohydrate metabolism through either decreased production of insulin or tissue resistance to the effects of insulin [14]. The former (Type-1 diabetes) is insulin-dependent; the latter (Type-2 diabetes) is non-insulin-dependent and primarily treated by dietary modification.

Taylor *et al.* (1998) tested the hypothesis that the risk for alveolar bone loss is greater, and bone loss progression more severe, for subjects with poorly-controlled Type-2 diabetes mellitus compared to individuals without Type-2 diabetes or with better-controlled disease [15]. The poorly-controlled group had glycosylated hemoglobin (HbA1) ≥ 9%; the better-controlled group had HbA1 < 9%. The study was conducted among residents of the Gila River Indian Community. Of 359 subjects aged 15 to 57 with less than 25% radiographic bone loss at baseline, 338 did not have diabetes, 14 were better-controlled diabetics, and 7 were poorly-controlled diabetics. Panoramic radiographs were used to assess interproximal bone level. Bone scores (scale 0-4) corresponding to bone loss of 0%, 1% to 24%, 25% to 49%, 50% to 74%, or ≥ 75% were used to identify the worst bone score in the dentition. Change in worst bone score at follow-up was specified on a 4-category ordinal scale as no change, or a 1-, 2-, 3-, or 4-category increase over baseline. Poorly-controlled diabetes, age, calculus, time to follow-up examination, and initial worst bone score were statistically significant explanatory variables in ordinal logistic regression models. Poorly-controlled Type-2 diabetes mellitus was positively associated with greater risk for a change in bone score (compared to subjects without diabetes). The cumulative odds ratio (COR) at each threshold of the ordered response was 11 (95% CI = 2.5, 53.3). When contrasted with subjects with better-controlled diabetes, the COR for those in the poorly-controlled group was 5 (95% CI = 0.8, 53.3). The COR for subjects with better-controlled diabetes was 2 (95% CI = 0.7, 6.5), when contrasted to those without diabetes. These results suggest that poorer glycemic control leads to both an increased risk for alveolar bone loss and more severe progression over those without Type-2 diabetes mellitus. There may also be a gradient, with the risk for bone loss progression for those with better-controlled Type-2 diabetes, intermediate between those for poorly-controlled diabetes and non-diabetics.

Using panoramic radiographs, a case-control study performed on 664 Japanese men aged 46-57 years assessed periodontal disease. This investigation also demonstrated a correlation between the degree of failure of control of Type-2 diabetes and the amount of alveolar bone loss [16]. Comparing diabetics to control subjects, a research report from Finland failed to demonstrate an increase in the microflora that could contribute to the increased rate of periodontitis [17].

The degree of marginal alveolar bone loss has also been assessed in a group of young subjects with Type-1 diabetes mellitus [18]. A clear trend towards increased marginal bone loss was seen in the subjects with the poorest controlled diabetes. The subjects with good metabolic control and no complications were no more susceptible to marginal bone loss than non-diabetic controls of the same age.

3. Hyperparathyroidism

Primary hyperparathyroidism is relatively rare and results from an excess secretion of parathyroid hormones due to a hormone-producing benign or malignant neoplasm [19,20]. Most persons with primary hyperparathyroidism are over age 60. Women are more commonly affected than men [14]. Secondary hyperparathyroidism results in excess secretion of parathyroid hormone due to parathyroid hyperplasia compensating for a metabolic disorder that has resulted in retention of phosphate or depletion of the serum calcium level [3]. Secondary hyperparathyroidism is most commonly found as a complication of end-stage renal disease, or renal osteodystrophy. The radiologic features of both forms of hyperparathyroidism are similar. These include generalized osteoporosis, unilocular or multilocular cystic radiolucencies in bone (Brown tumor), attenuation or loss of lamina dura surrounding the teeth, and calcifications in muscles and subcutaneous tissues (Fig. 2, 3).

It is often considered that histopathologic study of a biopsy specimen is the basis for diagnosis of "cystic" lesions of the jaws. Unfortunately, the Brown tumor provides no definitive histologic answer. Nuclear medicine or serologic confirmation is usually needed. The Brown tumor lesion is composed of fibrous connective tissue containing areas of hemorrhage and foreign-body type multinucleated giant cells. This can be easily confused with other conditions such as the giant cell tumor, foreign body granuloma, aneurismal bone cyst, or osteoclastoma.

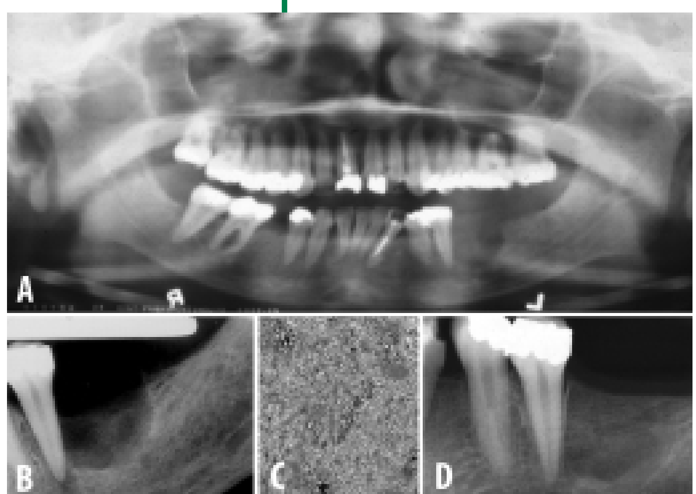


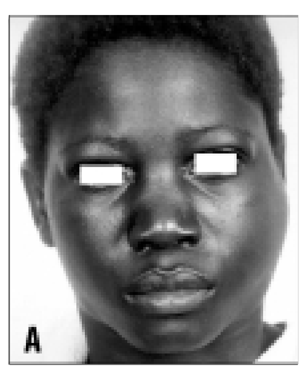
Fig. 2: Primary Hyperparathyroidism – A. Panoramic radiograph demonstrating unilocular cystic lesion distal to the left mandibular second premolar. B. Periapical radiograph showing loss of lamina dura distal to the left mandibular second premolar tooth. C. Histopathologic study of the Brown tumor showing numerous multinucleated giant cells. D. The lesion healed and the lamina dura reconstituted following removal of the parathyroid tumor.

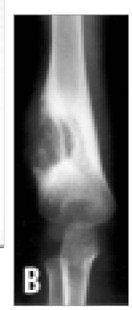
"It was concluded that panoramic radiography is useful in monitoring renal osteodystrophy, especially to assess the response to therapy such as parathyroidectomy or renal transplantation."

Fig. 3: Hyperparathyroidism – A. Granular appearance of skull in patient having renal osteodystrophy. B. Solitary "punched-out" radiolucency in calvarium represents a Brown tumor in secondary hyperparathyroidism. C. Right humerus shows coarse internal trabeculation in primary hyperparathyroidism (same case as shown in Fig. 2). D. Metastatic calcifications in hand and wrist of patient with primary hyperparathyroidism. E. Detail of calcifications adjacent to thumb (detail of 2.D).

In Italy, 45 patients afflicted with chronic renal failure (29 men and 16 women; mean age: 48 years) and on hemodialysis for 4 to 245 months (mean: 67 months) were examined using panoramic images plus radiographs of the skull, hands, shoulders and clavicles, pelvis and spine [21]. The control group (45 subjects with no renal diseases) was examined only by panoramic radiography. Dental and skeletal radiographs were rated on a 0-6 score and compared to assess possible relationships between skeletal and dental radiographic changes. Twenty-six dialysis patients (58% of all dialysis patients studied) had the following radiographic abnormalities in the jaws: osteoporosis (100%), lamina dura reduction or loss (27%), calcifications of soft tissues or salivary glands (15%), focal osteosclerosis adjacent to tooth roots (12%), and Brown tumors (8%). Radiographic abnormalities in the hand, shoulder and pelvis were found in 51% of dialysis patients. In the control group, only 16% had jaw lesions including osteopenia, cortex reduction at the mandibular angles and cyst-like lesions. Caries and periodontal disease experience did not differ between the dialysis group and the controls. It was concluded that panoramic radiography is useful in monitoring renal osteodystrophy, especially to assess the response to therapy such as parathyroidectomy or renal transplantation.

A Bosnian study of panoramic and periapical radiographs of 42 patients on hemodialysis and having renal osteodystrophy, demonstrated a progressive increase in periodontal disease, loss of lamina dura, deviation in the trabecular pattern, Brown tumor "pseudocyst" formation and pulp calcifications [22].





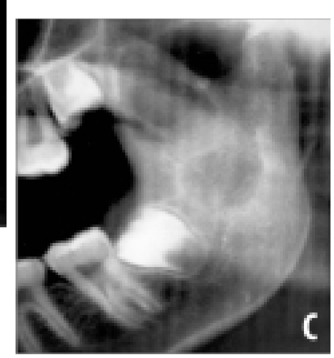


Fig. 4: Tuberculous osteomyelitis – A. Facial swelling is a frequent feature of this uncommon presentation of tuberculosis. B. Tuberculous osteomyelitis of long bone causing loss of cortical continuity. C. Detail from panoramic radiograph shows irregular radiolucency below the mandibular notch (tuberculous osteomyelitis).

4. Specific Infections

Not all systemic conditions that can produce jaw lesions are as common as the ones discussed above, but their detection is equally important for the correct treatment to be commenced. In the developed world there had been a decline in advanced lesions from specific infections; however, with a growing population of immune-compromised individuals as a result of the more widespread use of immunosuppressive regimens subsequent to organ transplantation, and through the AIDS epidemic, a resurgence of previously "vanquished" organisms is possible.

4.1. Tuberculosis:

Tuberculosis is a specific infection caused by the acid-fast bacillus *Mycobacterium tuberculosis.* Almost all cases arise from pulmonary disease. Involvement of the oral tissues is rare, occurring in less than one in 50 with tuberculosis [2]. Oral tissues are involved through direct inoculation, extension from other infection sites, or hematogenous seeding. Patients with jawbone lesions complain of repeated attacks of "toothache-like" pain and there is usually swelling of the affected area. Sinus tracts develop as the swellings rupture and may drain intraorally or extraorally. Trismus may be present, especially if the temporomandibular joint is involved.

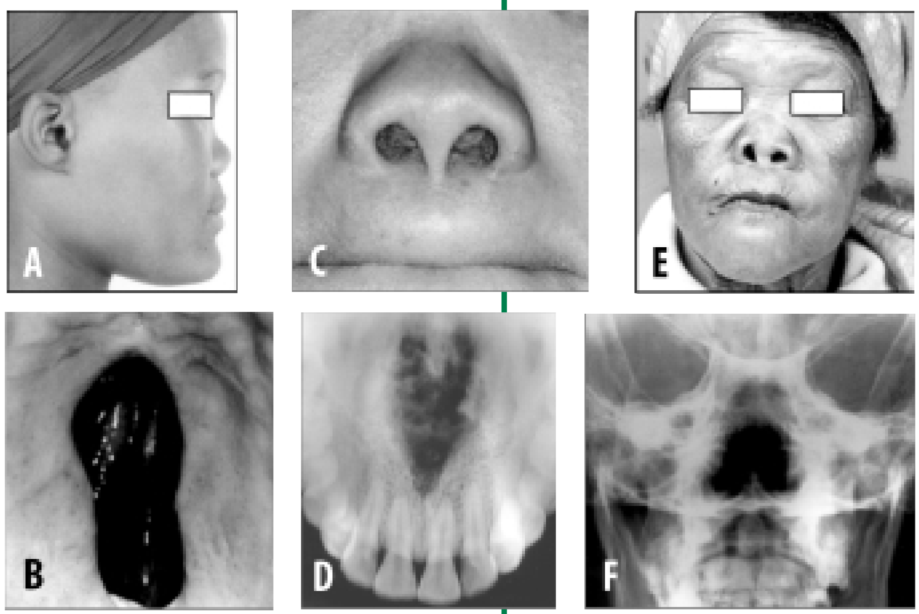
Lesions within the jaws (Fig. 4) can be rarefactions with ill-defined borders. There may be periosteal new bone formation. Sequestration of necrotic bone can occur. In addition to tuberculous osteomyelitis, calcified lymph upper cervical nodes from tuberculosis may also be detected on panoramic radiographs.

“ The cardinal radiographic signs of metastases to the jaw include a well circumscribed but uncorticated lytic lesion, especially in the posterior mandible, with highly irregular outline, or multiple small areas of bone destruction that gradually coalesce to form large ill-defined areas of bone destruction.”

4.2. Syphilis:

Syphilis is caused by infection with the spirochete *Treponema pallidum.* It may be congenital or acquired after birth. The acquired form can be subclassified into three distinctive stages: primary, secondary and tertiary. Bone may be affected in congenital syphilis and in both the secondary and tertiary stages of acquired syphilis (Fig. 5). The jaws are rarely affected by syphilis. When they are the palate is more frequently involved than the mandible. Radiographic features of bone involvement by syphilis include: deposition of subperiosteal new bone along the inferior border of the mandible (syphilitic periostitis); gummatous destruction of bone, especially the palate, resulting in a large radiolucent area; well-demarcated destruction along a cortical margin; or multiple radiolucencies with poorly-defined margins and sequestration (syphilitic osteomyelitis).

Fig. 5: A-D. Congenital syphilis. (Note deficient bridge of nose.) Lytic lesions in the center of the palate are outside the panoramic focal trough. E-F. Tertiary syphilis. (Note gummatous destruction in nasal cavity.)



5. Metastatic Malignancies

Metastatic tumors to the jaws are rarely reported; however, metastases may well constitute the most common malignant tumors affecting the skeleton [2]. Nevertheless, most metastases to bone are found in the spine, pelvis, skull, ribs, or the humerus. It is reported that approximately 1% of malignant neoplasms metastasize to the jaws, and metastases comprise about 1% of all oral malignancies. To qualify as a metastasis, the lesion must be localized to bone as distinguished from direct invasion – and it should be histopathologically verifiable as a metastasis. Most metastases occur in mature individuals over age 50. The process of metastasis occurs by one of three routes: seeding of an adjacent body cavity, lymphatic spread or hematogenous dissemination. The most common primary sites for tumors metastasizing to the jaws in adults are from organs below the clavicle, namely: breast, kidney, lung, colon, rectum, prostate, stomach, skin, testes, bladder, ovary, and cervix. Above the clavicle, the most frequent primary site for metastases to the jaw is the thyroid gland. In children metastatic disease is extremely rare. When this does occur in childhood, the primary cause is usually a neuroblastoma, retinoblastoma, or Wilms tumor.

The clinical presentation of metastatic disease to the jaws is nonspecific, including local pain, swelling, numbness, paresthesia of the lip and chin, and loosening or extrusion of the teeth. Pathologic fractures may also occur but are considered rare (Fig. 6).

The cardinal radiographic signs of metastases to the jaw include a well-circumscribed but uncorticated lytic lesion, especially in the posterior mandible, with highly irregular outline, or multiple small areas of bone destruction that gradually coalesce to form large ill-defined areas of bone destruction (Fig. 6 & 7). Ancillary signs include periapical or periradicular radiolucency or radiopacity without evidence of pulpal pathology, failure of an extraction socket to heal, generalized loss of the lamina dura, or “floating” teeth.

In a 12-month period, cancer metastatic to the mandible was diagnosed in eight patients at the Oral and Maxillofacial Surgery Clinic of the University of Vienna (1997) [23]. Six of them were presented with pain mimicking toothache, temporomandibular joint disorders, or trigeminal neuralgia, and two showed osteopenic bone lesions on panoramic radiography combined with perimandibular swelling. Anesthesia of the lower lip was the one common clinical feature in all eight cases. Histology revealed breast, lung, renal cancer, and a malignancy of inconclusive origin.

Thirty metastases of malignant tumors in jaws were retrospectively studied in the Pathology Department of the Hospital de la Pitie, Paris, France (1991) [24]. They occurred more often in women than in men (17 F:13 M). In 21 cases, the primary cancer was known and had been treated 1 to 4 years earlier. In the other 9 cases, discovery of the bone metastasis led to the discovery of a latent tumor. Clinical signs and symptoms included swelling, pain, loosening of teeth, and labio-mental anaesthesia, but rarely pathologic fracture. All but two patients had a radiolucent lesion. The metastases almost always involved the mandible (95 %), most often in the molar area or angle. Histologically, the majority of lesions were adenocarcinomas

" Early detection can lead to appropriate treatment and alleviation of untoward side affects. This is an area where the dentist may well save a life."

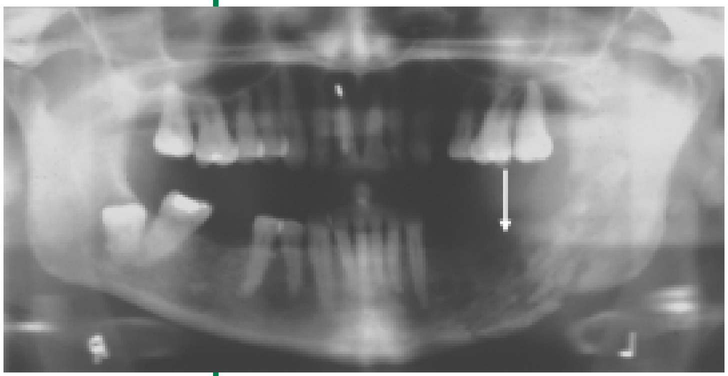


Fig. 6: Breast cancer metastasis to left mandibular body. Note "moth-eaten" appearance of the lesion and an associated pathological fracture.

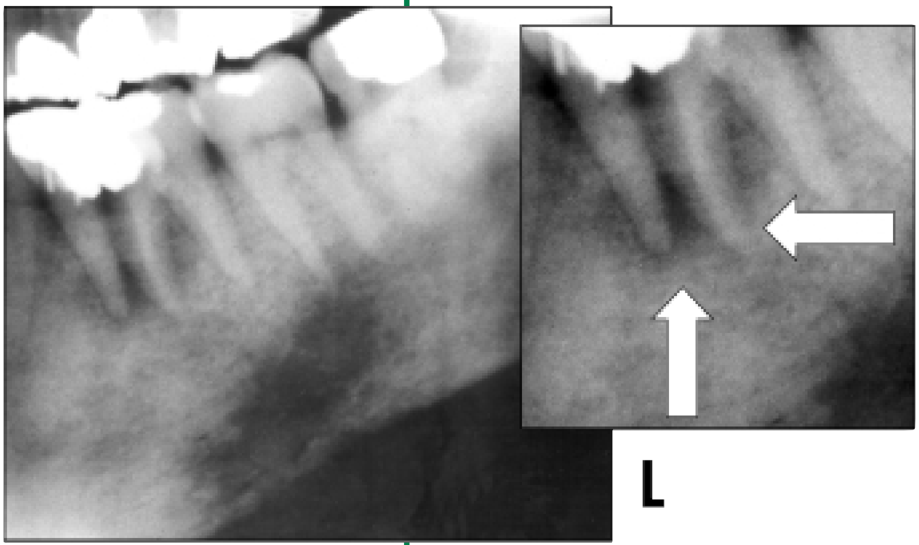


Fig. 7: Metastatic carcinoma. Note irregular "moth-eaten" rarefaction adjacent to first molar and second premolar teeth (detail from panoramic radiograph). Using the narrower perspective of a periapical radiograph, this lesion could well be misinterpreted as a simple "endo-perio" case.

from breast (33%) and alimentary canal (stomach, colon). Epidermoid bronchial carcinomas were seen in 5 cases and malignant melanomas in 2 cases. Only one sarcoma was involved, and this was from a liposarcoma of the thigh. In all but one patient, the disease was lethal over the short run.

6. Concluding Remarks

While some controversy remains concerning the value of using panoramic radiographs in the screening of systemic diseases, the dentist should be capable of detecting features of such conditions when they produce changes on panoramic radiographs. Such conditions can have a major impact on the quality of life of afflicted patients. Early detection can lead to appropriate treatment and alleviation of untoward side affects. This is an area where the dentist may well save a life.

References

1. Mohammad AR, Alder M, McNally MA. A pilot study of panoramic film density at selected sites in the mandible to predict osteoporosis. Int J Prosthodont 1996;9:290-294.
2. Farman AG, Nortjé CJ, Wood RE. Oral and maxillofacial diagnostic imaging. St Louis: Mosby-Year Book 1993.
3. Watson EL, Katz RV, Adelezzi R, Gift HC, Dunn SM. The measurement of mandibular cortical bone height in osteoporotic vs. non-osteoporotic postmenopausal women. Spec Care Dentist 1995;15:124-128.
4. Benson BW, Prihoda TJ, Glass BJ. Variations in adult cortical bone mass as measured by a panoramic mandibular index. Oral Surg Oral Med Oral Pathol 1991;71:349-356.
5. Taguchi A, Tanimoto K, Suei Y, Otani K, Wada T. Oral signs as indicators of possible osteoporosis in elderly women. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1995;80:612-616.
6. Taguchi A, Suei Y, Ohtsuka M, Otani K, Tanimoto K, Ohtaki M. Usefulness of panoramic radiography in the diagnosis of postmenopausal osteoporosis in women. Width and morphology of inferior cortex of the mandible. Dentomaxillofac Radiol 1996;25:263-267.
7. Horner K, Devlin H, Harvey L. Detecting patients with low skeletal bone mass. J Dent. 2002;30:171-175.
8. Nakamoto T, Taguchi A, Ohtsuka M, Suei Y, Fujita M, Tanimoto K, Tsuda M, Sanada M, Ohama K, Takahashi J, Rohlin M. Dental panoramic radiograph as a tool to detect postmenopausal women with low bone mineral density: untrained general dental practitioners' diagnostic performance. Osteoporos Int 2003;14:659-664.
9. Mohajery M, Brooks SL. Oral radiographs in the detection of early signs of osteoporosis. Oral Surg Oral Med Oral Pathol 1992;73:112-117. [From the University of Michigan School of Dentistry, Ann Arbor.
10. Klemetti E, Kolmakov S, Heiskanen P, Vainio P, Lassila V. Panoramic mandibular index and bone mineral densities in postmenopausal women. Oral Surg Oral Med Oral Pathol 1993;75:774-779.
11. Klemetti E, Collin HL, Forss H, Markkanen H, Lassila V. Mineral status of skeleton and advanced periodontal disease. J Clin Periodont 1994;21:184-188.
12. Persson RE, Hollender LG, Powell LV, MacEntee MI, Wyatt CC, Kiyak HA, Persson GR. Assessment of periodontal conditions and systemic disease in older subjects. I. Focus on osteoporosis. J Clin Periodontol 2002;29:796-802.
13. Lundstrom A, Jendle J, Stenstrom B, Toss G, Ravald N. Periodontal conditions in 70-year-old women with osteoporosis. Swed Dent J 2001;25:89-96.
14. Neville BW, Damm DD, Allen CM, Bouquot JE. Oral and maxillofacial pathology. Philadelphia: EB Saunders Company 1995.
15. Taylor GW, Burt BA, Becker MP, Genco RJ, Shlossman M. Glycemic control and alveolar bone loss progression in type 2 diabetes. Ann Periodontol 1998;3:30-39.
16. Marugame T, Hayasaki H, Lee K, Eguchi H, Matsumoto S. Alveolar bone loss associated with glucose tolerance in Japanese men. Diabet Med 2003;20:746-751.
17. Collin HL, Uusitupa M, Niskanen L, Kontturi-Narhi V, Markkanen H, Koivisto AM, Meurman JH. Periodontal findings in elderly patients with non-insulin dependent diabetes mellitus. J Periodontol 1998;69:962-966.
18. Tervonen T, Karjalainen K, Knuuttila M, Huumonen S. Alveolar bone loss in type 1 diabetic subjects. J Clin Periodontol 2000;27:567-571.
19. Morano S, Cipriani R, Gabriele A, Medici F, Pantellini F. Recurrent Brown tumors as initial manifestation of primary hyperparathyroidism. An unusual presentation. Minerva Med 2000;91:117-122.
20. Migita H, Ohno A. Oral bony lesion in a patient with medical history of hyperparathyroidism. Int J Oral Surg 1979;8:67-70.
21. Scutellari PN, Orzincolo C, Bedani PL, Romano C. Radiographic manifestations in teeth and jaws in chronic kidney insufficiency. Radiol Med (Torino) 1996;92:415-420.
22. Ganibegovic M. Dental radiographic changes in chronic renal diseases. Med Arh 2000;54:115-118.
23. Glaser C, Lang S, Pruckmayer M, Millesi W, Rasse M, Marosi C, Leitha T. Clinical manifestations and diagnostic approach to metastatic cancer of the mandible. Int J Oral Maxillofac Surg 1997;26:365-368.
24. Auriol M, Chomette G, Wann A, Guilbert F. Metastases of malignant tumor in the jaw. Analysis of 30 case reports. Rev Stomatol Chir Maxillofac 1991;92:155-159.

In The Recent Literature:

Osteoporosis: Mandibular cortical shape was significantly associated with biochemical mark so dentists may be able to identify postmenopausal women with low BMD by using dental panoramic radiographs.

Taguchi A, Sanada M, Krall E, Nakamoto T, Ohtsuka M, Suei Y, Tanimoto K, Kodama I, Tsuda M, Ohama K. Relationship between dental panoramic radiographic findings and biochemical markers of bone turnover. J Bone Miner Res 2003;18:1689-1694. [From the Department of Oral and Maxillofacial Radiology, Hiroshima University Dental Hospital, Japan.]

Recent studies suggest that mandibular inferior cortical shape and width on dental panoramic radiographs may be useful screening tools for low skeletal bone mineral density (BMD) or increased risk of osteoporotic fracture. Of 609 women who visited the authors' clinic for BMD assessment between 1996 and 2002, 82 Japanese postmenopausal women (age range 46-68 years of age; mean age 54 +/- 5 years), were recruited for a study to further examine this relationship. Biochemical markers of bone turnover and lumbar spine BMD measurements were compared with panoramic radiographic findings. Mandibular inferior cortical shape (normal, mild/moderate erosion, severe erosion) and width were evaluated on dental panoramic radiographs. BMD at the lumbar spine (L2-L4) was measured by DXA and categorized as normal (T-score > -1.0), osteopenia (T-score, -1.0 to -2.5), or osteoporosis (T-score < -2.5). Bone turnover was estimated by serum total alkaline phosphatase (ALP) and urinary N-telopeptide cross-links of type I collagen (NTx), corrected for creatinine. The odds of low spine BMD in subjects with mandibular cortical erosion were 3.8 (95% CI, 1.2-12.5). Mandibular cortical erosion was significantly associated with increased NTx ($p < 0.001$) and ALP ($p < 0.05$) levels. Mandibular cortical width was significantly associated with spine BMD but not with NTx and ALP levels. In conclusion, the results suggest that mandibular inferior cortical shape on dental panoramic radiographs may be an indicator of bone turnover and spine BMD in postmenopausal women. Dentists may be able to identify postmenopausal women with increased risk of osteopenia and osteoporosis on dental panoramic radiographs.

Radiation-associated meningioma: Full-mouth series performed 15-40 years ago, when radiation exposure from full-mouth series was greater than it is now, were associated with an increased risk of meningioma. No increased risk to meningioma was observed with panoramic radiographs, cephalograms or bitewings.

Longstreth WT Jr, Phillips LE, Drangsholt M, Koepsell TD, Custer BS, Gehrels JA, van Belle G. Dental X-rays and the risk of intracranial meningioma: a population-based case-control study. Cancer 2004 1;100:1026-1034. [From the Department of Neurology, University of Washington, Seattle, USA.]

Ionizing radiation is a likely cause of intracranial meningioma. The authors investigated whether the risk of intracranial meningioma was associated with past dental radiographic procedures; specifically, posterior bitewings, full-mouth series, and lateral cephalometric and panoramic radiographs. A population-based case-control study was made among residents of various counties in western Washington State. Case patients (n = 200) each had an incident of intracranial meningioma that was confirmed histologically. Random-digit dialing and Medicare eligibility lists were used to identify two control subjects to be age- and gender-matched to each case patient. Exposures were determined during an in-person interview. The authors compared self-report and dental records in a subset of study participants. Of the 4 dental radiographic procedures evaluated, only the full-mouth series (specifically, = 6 over a lifetime) was associated with a significantly increased risk of meningioma (odds ratio, 2.06; 95% confidence limits, 1.03-4.17). However, evidence for a dose-response relation was lacking (p for trend = 0.33). The risk was elevated with the aggregate number of full-mouth series in 10-year periods from approximately 15-40 years before diagnosis, with significant elevations in the 10-year periods beginning 22-30 years before diagnosis. The risks in these analyses were even greater when only women were considered.