

Floating Teeth Appearance: A Diagnostic Radiographic Alarm

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Submitted: 2019-09-13; **Accepted:** 2019-12-21; **Published Online:** 2020-01-07 **DOI:** 10.22037/rrr.v5i1.29629

Introduction: Floating teeth is a condition when teeth lose their supporting alveolar bone as a result of a destructive process, which is most frequently occur in the molar/ premolar region of both jaws .The aim of this study was to review the common conditions associated with floating teeth. **Materials and Methods:** We used general search engines and specialized databases including Google Scholar, Pub Med, Pub Med Central, Science Direct, and Scopus to find relevant studies by using keywords such as "jaw lesion", "jaw disease", "floating tooth", "floating teeth", "tooth mobility", and "tooth loss". About 100 articles were found, of which approximately 80 were broadly relevant to the topic, and finally 30 articles closely related to the above topic were chosen. **Results:** When the data were compiled, the following 9 lesions were found to have more relationship with floating teeth appearance: Aggressive periodontitis, Langerhans histiocytosis, Burkitt's lymphoma, multiple myeloma, Metastatic tumors, Primary intraosseous carcinoma (intraosseous squamous cell carcinoma), Ewing's sarcoma, Hyperparathyroidism, and Cherubism. **Conclusion:** When clinicians encounter a lesion associated with floating teeth, they should consider these entities especially malignant disorders in differential diagnosis to make more accurate diagnoses and develop better treatment plans according to patients' imagings.

Keywords: Bone loss; Bone resorption; Floating tooth

Introduction

Different jaw lesions might present with a similar radiographical pattern, which makes it difficult to differentiate among them (1). Despite availability of modern imaging modalities, plain radiography still remains the most important technique for investigation of jaw lesions (2). Precise history taking with details along with clinical features and analytical approach to radiographs helps the clinician narrow the differential diagnosis (1, 2). This paper focuses on "floating teeth" appearance as a possible radiographic diagnostic feature in differentiating jaw lesions, which is literally described as loss of supporting structures of teeth due to a destructive process. It is most frequently occurring in the molar/ premolar region of the maxillary and mandible (3, 4). Floating teeth appear as loss of alveolar bone, lamina dura, dental follicle in cases of un-erupted teeth, and root resorption (3, 5). Floating teeth are usually displaced occlusally in comparison to adjacent teeth. This radiographic feature can be seen locally or as a generalized pattern even with involvement of non-erupted deciduous or permanent teeth (4, 5). Oral examination generally reveals evidence of gingivitis, ulceration and hemorrhage. The involved teeth might be displaced, loose and freely movable (5). It is noteworthy that floating teeth might be associated with

malignancies. In a recent retrospective analysis of osseous changes in oral malignancy by Shah *et al.*, destruction of periodontal membrane and lamina dura were seen in all patients. Floating tooth, pathologic fracture, and root resorption were also seen in 50%, 30%, and 15% of cases, respectively (6). Based on a review of the literature we proposed a category of 9 jaw lesions with floating teeth comprising inflammatory, neoplastic, and metastatic entities. When clinicians encounter floating teeth in jaw radiographs, they should first preclude these entities in order to make more accurate diagnoses and develop better treatment plans.

Materials and Methods

Authenticated engines and databases such as Google Scholar, PubMed, PubMed Central, Science Direct, and Scopus, and well-recognized textbooks, were used to find relevant studies by using "jaw lesion", "jaw disease", "floating tooth", "floating teeth", "tooth mobility", and "tooth loss" as keywords. More than 100 articles were found, of which approximately 80 were intimately relevant to the topic. Finally, 30 relevant English articles published from 1984 to 2018 including 19 original articles, 1 review article and 10 case reports and case series were reviewed.

Table 1. The characteristics of the lesions associated with floating teeth appearance

Entity	Age predilection	Sex predilection	Predominant jaw	Radiographic feature	Oral lesion rate
Aggressive Periodontitis (7-9)	Young	M>F	Man	“arc-shaped” mirror image radiolucency(localized)- mild crestal bone resorption to severe extensive alveolar bone destruction (generalized)	100%
Langerhans Histiocytosis (10,11)	infants and young children	M>F	Man	lytic bone lesions , the lamina dura and surrounding bone along with the periodontium are destroyed	77%
Burkitt’s Lymphoma (13,14)	5-7 y (Endemic) 12 y (Sporadic)	-	Man	enlargement of developing tooth crypts and loss of lamina dura, Osteolytic lesions in the jaws	30 %
Multiple Myeloma16,17	50-70 y (mean age=60 y)	M>F	Man	“punched-out” osteolytic bone lesions	5-30 %
Metastatic Tumors (18,19)	40-70 y	M=F	Man	absence of any manifestation to a lytic or opaque lesion with ill-defined margins	25%
Primary Intraosseous Carcinoma (21,22)	50-70 y	M>F	Man=Max	uni or multilocular radiolucencies with periphery raggedness or ill-defined	6%
Ewing’s Sarcoma (23-25)	5-20 y	M>F	Max=Man	ill-defined radiolucency	1%
Hyperparathyroidism (26-28)	30-60 Y	F>M	Man	osteoporosis and generalized rarefaction	-
Cherubism	1-5 y	M>F	Man	bilateral, well-defined, multilocular radiolucencies	-

Results

Review of the literature showed that 9 lesions have a prominent relationship with floating teeth appearance: aggressive periodontitis, Langerhans histiocytosis, Burkitt’s lymphoma, multiple myeloma, metastatic tumors, primary intraosseous carcinoma (intraosseous squamous cell carcinoma), Ewing’s sarcoma, hyperparathyroidism, and cherubism. The characteristics of these lesions are summarized in Table 1.

Aggressive periodontitis

Aggressive periodontitis-diffuse atrophy of the alveolar bone- is a type of periodontitis appearing as rapid destruction of alveolar bone and periodontal ligament mainly seen in healthy young people with a racial and sex predilection to blacks and men (7, 8). Although much less common than chronic periodontitis, aggressive periodontitis can cause early tooth loss if not diagnosed timely. The disease might develop as localized or generalized forms with their specific characteristics. Gingival bleeding along with progressive spacing of anterior teeth in young patients comprise the classic form of the disease, however the elderly can be involved as well. Radiographically (Figure 1), the localized

form of floating tooth presents as an “arc-shaped” mirror image radiolucency in first molars from distal aspect of second premolars to mesial aspect of second molars (7, 9). Floating teeth may be also seen in endodontic-periodontal lesions (9). In generalized form, a mild bony resorption in alveolar crest to severe extensive destruction in alveolar bone might be seen depending on the severity of disease (7).

Langerhans histiocytosis

Langerhans histiocytosis (Histiocytosis X) is an infrequent hematological disorder mainly affecting infants and young children with a peak incidence of 0.5 to 5.4 cases per million people per year (10). Men are affected more frequently with a racial predilection for Asian population (10, 11). Langerhans histiocytosis can present with nonmalignant or malignant behavior. Nonmalignant disorder includes unifocal and multifocal eosinophilic granuloma, while malignant type includes Letterer Siwe disease and variants of histiocytic lymphoma. It most commonly affects head and neck region including the oral cavity (10). Main Clinical features are gingival hyperplasia, bleeding, recession and necrosis, ulcerative lesions, impaired healing, destruction of the alveolar bone, halitosis and odontalgia in more cases. The



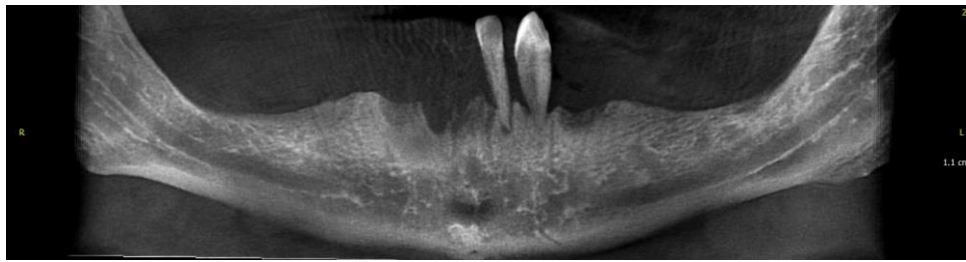


Figure 1. A panoramic reconstructed cone-beam computed tomographic image shows floating teeth appearance in the mandibular incisor region associated with Periodontitis



Figure 2. A panoramic image shows floating teeth appearance in the mandibular molar region (left side) and maxillary lateral incisor associated with Langerhans Histiocytosis

incidence of oral lesions is as high as 77%; however, 10% to 20% of them can be non-specific for the disease (11). Radiographically (Figure 2), lytic bone lesions, especially in the posterior portion and ramus of the mandible, have been reported in 5% to 10% of patients. Involvement of alveolar bone leads to destruction of periodontium (lamina dura and surrounding bone) and floating teeth appearance and tooth displacement (10, 11). In addition, floating teeth appearance is pathognomonic for diagnosis of histiocytosis in children according to the literature (5). According to Estela *et al.*, oral manifestations of Langerhans histiocytosis might be the first and/or only sign of the disease, and floating teeth are the most typical radiographic sign of the disease (12).

Burkitt's lymphoma

Burkitt's lymphoma-a subtype of non-Hodgkin lymphoma-is the most rapidly growing malignant neoplasm in humans, which comprises 40% of all childhood non-Hodgkin lymphomas (13, 14). Its incidence is highly dependent to geographic location for example in equatorial Africa, it accounts for 50% to 75% of all malignancies in children. The endemic form of disease is usually diagnosed between the age of 5 and 7 years, with involvement of

jaws and other facial bones in 60% to 80% of cases. In contrast, elder children (mean age of 12 years) are mainly affected by the sporadic form of disease (13). After the abdomen which is the mostly affected site involvement of maxillofacial bones has been reported in 30% of cases (13). It seems that anatomical site of involvement plays a key role on clinical features of the disease. Obstruction of airways, intestines and biliary tract, mobility of teeth, toothache, gingival enlargement, jaw expansion, and sensory disturbances are among common clinical features (13, 14). The sporadic form of Burkitt's lymphoma is mainly presented by inferior alveolar nerve paresthesia (13). Some radiographical signs such as enlargement of developing tooth crypts and loss of lamina dura occur early in the course of disease (Figure 3). Other reported features are osteolytic lesions around the permanent tooth buds, widening of follicular space, and floating teeth appearance (14). Cho *et al.* showed that despite clinically advanced disease with involvement of most organs floating teeth appearance was the only problem detected before other symptoms appeared (14). This finding was reported by Sinclair *et al.*, in a 12-year-old boy with dental manifestations as well (15).





Figure 3. A panoramic image shows floating teeth appearance in the maxillary and mandibular bones associated with Burkitt's lymphoma

Multiple myeloma

Multiple myeloma, malignant neoplasm of plasma cells, affects elderly patients more commonly (mean age of 60 years) with a male sex predilection (16). It accounts for 1% of all malignant neoplasms and 10% to 15% of hematologic malignancies (17). Early manifestations of multiple myeloma include bone pain (68%), anemia (62%), renal insufficiency (55%), hypercalcemia (30%), hepatomegaly (21%), and splenomegaly (5%) (16). Jaw lesions are seen in nearly 5% to 30% of patients with multiple myeloma mainly in mandibular molar region, ramus, condylar process and the angle of the mandible. About 14% of patients develop oral findings as the first signs of disease including swelling, pain, numbness of the jaws, gingival enlargement, or unexplained mobility of teeth (16, 17). Radiographical features such as “punched-out” lytic bone lesions in the jaws and the skull might draw attention to the possibility of multiple myeloma (17).

Metastatic tumors

Metastasis to the oral cavity is a rare phenomenon, which comprises about 1% to 1.5% of all oral malignancies mostly seen in patients between 40 and 70 years with no sex predilection (18, 19). Generally, jawbones are affected more frequently than oral soft tissues especially in younger patients, and the mandibular molar region is the most common site of involvement (18). Major primary sites for oral metastases in men are lungs, kidneys, liver, and prostate, while in women cancers of breasts, genital organs, kidneys, and colo-rectum metastasize to oral cavity (18, 19). It is noteworthy that metastases to oral cavity is the first sign of metastatic spread in 25% of cases, and it is the first sign of an unknown malignancy at a distant site in 23% of cases (19). Clinical features are swelling with tenderness, pain, ulcer; hemorrhage, paresthesia and pathological fractures (18).

Radiographic findings (Figure 4) in metastases to the jawbones may vary from no signs to a lytic or opaque lesion with ill-defined borders (18). Extensive bone resorption with a floating tooth appearance has also been reported (3, 4, 19, 20).

Primary intraosseous carcinoma

Primary intraosseous carcinoma is considered the most aggressive type of squamous cell carcinoma in the jaws, which comprises about 6% of all malignant tumors of maxillofacial region (21). It is usually seen in sixth to seventh decades of life with a male sex predominance in the posterior portion of the mandible and the anterior region of the maxilla. It is not clinically evident until it progresses to a large lesion with pain, swelling, sensory nerve disorders, tooth mobility, trismus and lymphadenopathy (21, 22). That is why this entity is called a “silent killer” (21). Radiographically (Figure 5), it is characterized by uni or multilocular radiolucencies with ragged margins. Alveolar bone loss and floating teeth appearance have been reported as well (21). According to Huang *et al.*, almost all tumors were radiolucent with 16% of cases being closely related to an impacted wisdom tooth (22). Huang *et al.*, also noticed that despite prominent bone destruction in primary intraosseous carcinoma; root resorption of affected teeth was not a common finding; therefore a typical floating teeth pattern might develop (22). Furthermore, soft tissue squamous cell carcinoma can invade to bony structures surrounding teeth, which results in periodontal ligament widening with loss of lamina dura and floating teeth feature (23).

Ewing's sarcoma

Ewing's sarcoma is found to be the second most common primary malignant bone neoplasm in children (24), which accounts for about 6% of all malignant bone tumors (25).





Figure 4. A panoramic image shows floating teeth appearance in the maxillary posterior area (left side) associated with Metastatic tumor

Approximately 4% of the lesions appear in the head and neck region, with 1% of them being in the jaws (25). The posterior portions of the jaws are affected 4 times more likely than anterior regions (24). Age is an important factor for diagnosis of this entity, because it affects people between 5 and 20 years primarily (up to 80%), and rarely seen in patients over 30 years (25). The disease occurs commonly in whites and men (24). In the orofacial region, it is clinically characterized by swelling, pain, paresthesia, ulceration, and tooth loss (24, 25). The radiographic findings of Ewing's sarcoma are ill-defined lytic bone lesions, cortical erosion, loss of lamina dura, periodontal ligament widening, destruction of tooth follicles, and periosteal reactions (23). Root resorption is not a characteristic feature, but destruction of the supporting bone of adjacent teeth, which leads to floating tooth appearance might occur (23-25). Generally, invasive bone destruction is a critical radiographic feature seen in about 90% of patients ranging from pin- head sized holes, moth eaten, rotten wood to nearly purely lytic pattern with or without associated sunray spicules of the periosteal bone.

Hyperparathyroidism

Hyperparathyroidism is an endocrine abnormality characterized by excess of circulating parathyroid hormone. According to the etiology three types of hyperparathyroidism are known as primary, secondary, and tertiary (23). It affects 0.05% to 0.1 % of the general population with a prevalence of 1 in 400 females and 1 in 1000 males. The mandible is more frequently involved than maxilla in the maxillofacial area (26). Most cases appear in patients between 30 and 60 years of age (27). In the oral cavity, the most common manifestations are tooth mobility, drifting of teeth, sensitive teeth in mastication and pressure, alteration in dental eruption, diastema, complaint of vague jawbone pain and malocclusion (28). Radiographically osteoporosis and

generalized rarefaction (Figure 6) are recognized as the most common findings followed by loss of lamina dura, periodontal ligament widening, loss of cortical bone thickness at the inferior border and angle of the mandible, floating teeth appearance, and soft tissue calcifications (26-28).

Cherubism

Cherubism is a progressive, hereditary fibro-osseous lesion exclusively seen in the jaw bones (29); hence an odontogenic origin has been proposed for it (30). The first signs of the disease appear between 14 months and 5 years of age as bilaterally symmetrical diffuse facial swellings, which progress until puberty (29). There is a sex predilection in males with a male to female ratio of 2:1(31). Based on the clinical and radiographical features cherubic lesions are classified as quiescent, non-aggressive and aggressive (29). The mandible is more affected than maxilla and bone changes generally start in the angle and ascending ramus of the mandible and tuberosity of the maxilla (30). When the maxilla is affected the floor of the orbits moves upward leading to retraction of lower eyelids. Hence a thin rim of sclera is exposed giving the appearance of heavenly gaze in cherubic patients (22, 30). Cherubism is characterized by bilateral, well-defined, multilocular radiolucencies, thinning of the cortex, and bicortical expansion of the jaws (23, 29). Some other dental alterations and anomalies in these patients including ectopic tooth eruption, agenesis of permanent teeth (mostly first and second permanent molars), root resorption, tooth impaction, dilacerations, floating teeth appearance, dens invaginatus, taurodontism, talon cusps, and complex composite odontoma (29, 30). These anomalies result in malocclusion as well as difficulty swallowing and problems of phonation, the latter being aggravated by inversion or flattening of the palatal cleft (30).





Figure 5. A panoramic image shows floating teeth appearance in the maxillary posterior area (right side) associated with Primary intraosseous carcinoma (central SCC)

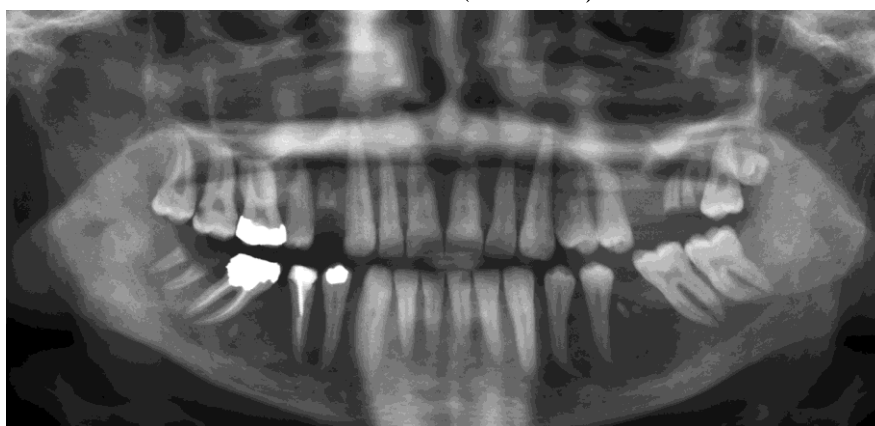


Figure 6. A panoramic image shows generalized floating teeth appearance associated with Hyperparathyroidism

Others

Except for the above-mentioned conditions, there are several less common lesions associated with floating teeth which are listed as fibrosarcoma, lymphosarcoma, reticulum cell sarcoma, familial dysproteinemia, leukemia, and Gorham-stout syndrome (4, 31).

Discussion

“Floating teeth” appearance can be divided into five major categories in terms of pathogenesis: Inflammatory lesions (advanced periodontitis), neoplastic or tumor like lesions (Burkitt’s lymphoma, multiple myeloma, intra bony carcinoma, Ewing sarcoma, oral metastasis, fibrosarcoma, lymphosarcoma, reticulum cell sarcoma, leukemia, langerhans cell disease, endocrine disorders (hyperparathyroidism), fibrosarcoma lesions (cherubism), and syndromes such as Gorham syndrome. Therefore, many of lesions associated to “Floating teeth” appearance is of malignant origin, which accentuates the necessity for paying attention to this radiographic feature. The prognosis of malignant lesions is significantly depending on

timely diagnosis and early treatment, hence consideration to warning radiographical signs is of paramount importance to establish a rapid and precise diagnosis.

Among lesions with “Floating teeth” appearance some affect infants and children predominantly such as LCH (10), Burkitt’s lymphoma (13), Ewing sarcoma (24), and cherubism (29). In addition, chronic periodontitis (7, 8), some types of Burkitt’s lymphoma (13), and in some circumstances Ewing sarcoma occur in the adolescent and young people (25). On the other hand, some of lesions representing this feature appears in adulthood e.g. multiple myeloma (16), intrabony carcinoma (21), metastatic tumors (18, 19), and hyperparathyroidism (26). Most of the lesions associated with “Floating teeth” appearance show a male predilection except for hyperparathyroidism (7, 10, 11, 16, 21, 24, 27, 30). Moreover, no sex or racial preference were found in metastatic tumors (18). The most affected site of involvement by lesions having “Floating teeth” appearance is posterior areas of mandible (10, 11, 16, 18, 21, 22, 24). As the majority of lesions related to such radiographic pattern are malignant in nature, it is recommended that when clinicians



confront this feature first consider the above-mentioned entities, and then arrange the differential diagnosis according to other factors of age, sex, and location. This approach will more likely help health practitioners make earlier decisions to order additional investigations (lab tests,) to reach at accurate diagnosis as soon as possible.

Conclusion

When clinicians encounter a lesion associated with floating teeth, they should consider these entities especially malignant disorders in the differential diagnosis.

Conflict of Interest: 'None declared'.

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Please cite this paper as: Mortazavi H, Safi Y, Khalighi HR, Forouzani G, Behnaz M. Floating Teeth Appearance: A Diagnostic Radiographic Alarm. *Regen Reconstr Restor*. 2020;5 (1): e6. Doi: 10.22037/rrr.v5i1.29629.

