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A CLASSIFICATION FOR RADIOLUCENCIES CROSSING MIDLINE OF MANDIBLE BASED ON A REVIEW

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ABSTRACT

Radiolucencies involving jaws, anatomic or pathologic are very common, which can occur both in maxilla and mandible. Among these, pathologic radiolucencies involving the midline of the mandible are rare. Despite advanced diagnostic methods, radiograph still remains the first and the most important investigation method. Even an extensive literature search did not yield a proper classification system for radiolucencies crossing the midline of mandible. To help the practitioner narrow down the differential diagnosis, a review of English literature was done and 134 articles found appropriate were selected. Apart from Central Giant Cell Granuloma, which was the most common radiolucency crossing the midline of mandible, 27 other lesions were detected, making the total number to 28. Based on this review, a classification system for radiolucencies crossing the midline of the mandible has been proposed.

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INTRODUCTION

Recognizing the nature of oral cavity lesions has been proposed as an essential role of general dental practitioner.[1] Every abnormal radiolucencies, in the radiographic images of jaw should be carefully analyzed, which will enable the practitioner to reach the correct diagnosis, so as to formulate a precise treatment plan.[1] For the purpose of evaluation of jaw lesions, even if many modern imaging techniques have been developed, radiography still remains the most important and practiced method.[2] Radiologic findings, even if may be non-specific, can provide valuable information for histologic diagnosis.[2]

Mandibular anterior region has been implicated as a very rare site for the formation of intrabony pathologies[3] for which the cause may be odontogenic or non-odontogenic.[4] This journal is intended to provide a classification system for pathologic radiolucencies crossing the midline of mandible based on a review, so as to help to narrow down the differential diagnosis and to formulate a specific treatment plan.

MATERIALS AND METHODS

Case reports, reviews and original studies in English literature were searched and 134 appropriate articles were selected. The criteria for selection were pathologies which crossed the midline of mandible. Search were conducted using Google scholar and EBSCO host. Articles which stated that lesions crossed the midline of mandible and lesions on the anterior mandible were included in the review. Radiolucencies which were associated/not associated with tooth roots and lesions which occurred rarely with one or two case reports were also included. Radiolucencies due to trauma, such as fracture were not included in the study.

RESULTS AND DISCUSSION

134 articles were selected (including text books) and based on these, 28 lesions involving mandibular midline were identified. The classification based on this review has been summarized in Table 1. Rather than attempting to describe each lesion in detail, the article has concentrated on the literature review about lesions crossing mandibular midline.

Tumours

Central Giant Cell Granuloma (CGCG)

CGCG is a benign, non-neoplastic proliferation .[5] Features of CGCG are comparable to a benign tumor[6] and accounts for upto 7% of benign lesions of jaw[7], but, World Health Organization (WHO) considers this as a bone related disorder.[6] CGCG mostly presents as a radiolucency on anterior mandible

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crossing the midline[8,9], which may be associated with teeth displacement, root resorption / cortical bone perforation.[10]

Odontogenic Myxoma (OM)

OM is an aggressive, locally invasive, benign, non-metastasizing jaw bone tumor,[11,12] with posterior mandible accounting for 2/3rd of the jaw lesions.[13,14] It presents either as uni/multilocular radiolucency.[15] In a study of 25 cases of OM over 20 years, by Tie Jun Li *et al*, reported 12 cases occurring in the mandible, including one case crossing the midline.[16] Mittal *et al*;2016, Aditya *et al*; 2016, Madiyal *et al*;2017, reported about radiolucent lesions, crossing the midline of mandible, which was later diagnosed as OM.[17,18,19]

Ameloblastoma

Ameloblastoma is the 2nd most common tumor of odontogenic origin,[20] with 80% in the mandible.[21] 10% cases have been reported in the anterior region.[20] Rastogi *et al*; 2010, Kashyap *et al*;2012, Ruqaya & Singh; 2014 and Reddy *et al*; 2015 reports ameloblastoma cases which crossed the mandibular midline.[22,23,24,25]

Ameloblastic Carcinoma (AC)

AC, a rare malignant ulcerative lesion,[26] 60% occuring in mandible.[27] Radiographic features of AC are different from that of ameloblastoma.[28] Cases of AC's crossing the midline of mandible were reported by Augustine *et al*;2013 and Khan *et al*;2014.[26,29]

Ewings Sarcoma (ES)

Most preferred location of ES of jaw being posterior mandible, Mukherjee *et al*; 2012, Ko *et al*; 2013 reported these in anterior mandibular region.[30,31] Ko *et al* reported of knowing one documented case of ES in the anterior mandible which was reported by Arafat *et al* in 1983.[30] A review based on a systematic literature search comprised of 53 articles, and contained information about 71 cases of ES, by Munoz *et al* in 2017, reported that most preferred site was mandible (69%).[32]

Osteosarcoma

Osteosarcoma's are rare in jaws.[33] In radiograph, it shows a mixed radiolucent/radiopaque appearance.[34,35] Among osteosarcomas of jaw, lesions mostly occur on mandible, with the preferred location being posterior body and ramus region.[36] In 2016, Flores *et al*, reported a case of osteosarcoma of jaw in a 55 year old female, which crossed the midline.[37]

Adenomatoid Odontogenic Tumor (AOT)

AOT most commonly occurs in the maxillary anterior region.[38] Srihari TG;2011, Subramaniam *et al*;2012, Qari *et al*;2014, Jindal;2014, Seo *et al*;2015, Gill DG & Schlieve TS;2016, Nair M *et al*;2017 and Gupta *et al*;2017 reported interesting cases of AOT crossing the midline of mandible.[38,39,40,41,42,43,44,45] In a retrospective study over a period from 2010-2013, by Jiang *et al* in 2014, 8 cases of AOT were identified, in which occurrence of lesion in maxilla and mandible was in the ratio of 6:2.[46] In this, one case was having a large radiolucency in the anterior portion of mandible, which crossed the midline of mandible.[46]

Keratocystic Odontogenic Tumor (KCOT)

Odontogenic Keratocyst (OKC), is designated by World Health Organization (WHO) as KCOT, because of its tumor like properties.[47] Lesions of KCOT crossing midline are rare.[48,49] Kumar *et al*;2005, de Lima Junior *et al*;2006, Rajkumar *et al*;2011, Veena *et al*;2011, Pillai *et al*;2013, Ramaswamy *et al*;2013, Sulabha *et al*;2013, Kshirsagar *et al*;2014, Subramaniam *et al*;2014, Chaudhari *et al*; 2015, Agarwal;2015 and Gurugubelli *et al*;2016 reported different cases of KCOT which were crossing the midline of mandible.[50,51,48,52,53,54,47,55,56,57,58,59] Ogunsalu *et al*; 2007, in a study reported 5 new cases of OKC during a period of 15 years.[60] In these, one case was presented with a radiolucency crossing the mandibular midline.[60] Khan *et al*;2009, in a study over a period of 5 years, 30 cases were identified as KCOT, of which 6 (20%) were present on the anterior body of mandible crossing the midline.[61] Murad AH; 2011, in a study, over a period of 10 years (1990-2000), 52 cases were identified as KCOT, in which 6 (11.5%) were reported to be on the anterior mandible.[62]

Calcifying Cystic Odontogenic Tumor (CCOT)

CCOT occurs almost equally in maxilla & mandible, with a predilection for anterior region.[63,64] Ledesma Motes *et Al*;2008 conducted study of 122 reported tumors, of which 113 were CCOT.[65] Of these, 6 (5.3%) were reported to be on anterior mandible.[65] Lesions diagnosed as CCOT, crossing midline of mandible were reported by Taghavi *et al*;2009, Utumi *et al*;2012, Aparna *et al*;2013, Devaraju *et al*;2015 and Narayan *et al*;2015.[66,67,68,69,70]

Chondrosarcoma

Chondrosarcoma mostly occurs in anterior maxilla.[71] Shirato *et al* in 2006, reported about 12 known cases of chondrosarcoma in the mandibular symphyseal region, and added one more to the list.[72] In 2007, Saini *et al* reported a chondrosarcoma, involving symphysis menti.[71] Myers *et al*;2009 reported a case of chondrosarcoma in the anterior mandible which was earlier recorded by Zakkak *et al* in 1998.[73]

Ghost Cell Odontogenic Carcinoma (GCOC)

GCOC is a very rare odontogenic malignant tumor, with only 37 cases in English literature till date to which Du *et al*; 2017 added one more.[74] Based on this it have been proposed that, GCOC mostly will cross the midline of mandible.[74] Other cases of GCOC crossing midline of mandible were reported by Kim *et al*;2001, Yuwanati *et al*;2012, Ismerim *et al*;2015 and Du *et al*;2017[74,75,76,77]

Dentinogenic Ghost Cell Tumor (DGCT)

DGCT is a neoplastic variety of Calcifying Odontogenic Cyst.[78] According to Patil K *et al*;2008, only 16 cases of DGCT are reported.[78] Kumar *et al*;2010, reported about 16 cases of DGCT and included one more case to the list.[79] Of these 17 cases, 4 were present on anterior mandible.[79] Garcia *et al*; 2015, found 41 reported cases of DGCT, and added one more to the list.[80] Other cases of GDCT which crossed the midline of mandible were reported by Patil *et al*;2008,Garcia *et al*;2015, Bafna *et al*;2016 and Arora *et al*;2017.[78,80,81,82]

Intraosseous Carcinoma

Kaffe *et al*;1998, studied primary intraosseous carcinoma of jaws in 24 cases, and detected 19 in mandible and one (5%) on anterior mandible.[83] A case with complete absence of mandible was reported by Reddy *et al* in 2012.[84] In a 10 year retrospective study by Wenguang *et al*;2016, among 77 patients with intraosseous carcinoma, 55 were in the mandible (71.4%) and 14 (25.5%) in the mandibular anterior region.[85] Tiwari *et al*;2011 and Naferjadeh *et al*;2016 also reported intraosseous carcinoma of anterior mandible.[86,87]

Manifestations of Endocrine Disorders

Browns tumor of hyperparathyroidism

In a study by Rai *et al*;2012, 26 patients with hyperparathyroidism were reviewed, of which only 1 was having browns tumor, and reported it to be very rare.[88] Karunakaran *et al*;2010, Verma *et al*;2014 and Nunes *et al*;2016 reported cases of browns tumor which were crossing midline of mandible.[89,90,91]

Manifestations of Fungal Infections

Mucormycosis

Literature search for mucormycosis involving midline of mandible revealed only reported 1 case by Oswal *et al*; 2012.[92]

Cysts

Developmental

Dentigerous Cyst (DC)

Cases of DC crossing the midline of mandible were reported by Gonzalez *et al*; 2011, Paul *et al*;2013, Bava *et al*;2014 and Nagaraj *et al*;2017.[93,94,95,96]

Median Mandibular Cyst (MMC)

MMC is an uncommon cyst occurring in the symphyseal region of mandible.[97] Maki *et al*, reported a case of MMC in 25 year male which was crossing the midline of mandible.[98]

Glandular Odontogenic Cyst (GOC)

GOC is a rare developmental cyst, with only 111 cases reported in the English literature.[99] 87.2% GOC occurs in the anterior mandible, mostly crossing the midline of mandible.[100] Shah *et al*;2014 reported a case of GOC in anterior mandible which crossed the midline.[99] Faisal *et al*;2015, in a review of 181 cases of GOC, reported that, GOC mostly occurs in anterior mandible crossing the midline of mandible and also reported another case of GOC which crossed the midline of mandible.[101]

Inflammatory

Radicular Cyst

Literature search revealed many case reports radicular cyst crossing the midline, namely, Venkateshwar G *et al*;2013, Grover N *et al*;2014, Bohra *et al*;2014, Rai NP *et al*;2015, Singhal I *et al*;2016, Borkar SA *et al*; 2016.[102,103,104,105,106,107]

Residual Cyst

In an analysis of 2944 cases of odontogenic cyts, Ochsenius *et al* ;2007, reported 328 residual cysts, of which 24 on anterior mandibular region.[108] Sridevi *et al* reported another case of residual cyst on the anterior mandibular region crossing the midline of mandible.[109]

Fibro-osseous Disorders

Ossifying Fibroma (OF)

Lasisi *et al* in 2014, conducted study on 121 histologicaly diagnosed cases of Fibro-osseous lesions of which 75 cases were Ossifying Fibroma.[110] 75% of lesion's, which crossed the midline of mandible were OF's, and stated that OF's can be compared to CGCG with respect to this behaviour.[110]

Cemento-Ossifying Fibroma (COF)

Jayachandran *et al*; 2010, Rangil *et al*; 2011 and Pancharethinam *et al*;2016 reported lesions crossing the midline of mandible, which were later diagnosed as COF.[111,112,113]

Florid Cemento Osseous Dysplasia (FCOD)

Chaudhary *et al*; 2015 and Chaurasia A; 2016 reported separate cases of FCOD's which occurred in the anterior mandibular region crossing the midline.[114,115]

Periapical Cemental Dysplasia (PCOD)

90% of PCOD's occur in anterior mandible.[116] Morikava *et al* and Senia & Sarao reported cases of PCOD involving midline of mandible.[117,118]

Bone Disorders

Cherubism

Cases of Cherubism showing multilocular radiolucencies, involving mandible, including the symphysis region was reported by Reddy *et al*;2012, Singh P *et al*;2013, Shah K *et al*;2013, Pinheiro *et al*;2013 and Joseph *et al*; 2017.[119,120,121,122,123]

Idiopathic/Others

Traumatic Bone Cyst (TBC)

Sandev *et al*;2001, conducted a review of 255 cases of TBC during the time period 1955 - 1979 (34 years), and reported that 89% cases occurred in the mandible including 25% in the frontal region.[124] A review of 26 cases of TBC's by Martins-Filho *et al*;2012, during a period of 15 years (1992-2007) reported 8 cases (30.8%) in the anterior mandible.[125] An extensive review of TBC (597 cases) was done by Titsinides & Kalyvas;2016 and reported that, second most common area of occurrence was anterior mandible.[126] Individual cases involving midline were reported by Dixit *et al*.2015 and Nagaraj *et al*;2017.[127,128]

Aneurysmal Bone Cyst (ABC)

Majority of ABC occurs in the posterior mandibular region, but 9% cases have been reported to occur in the mandibular symphysis region.[129] Other cases, crossing the midline, have been reported by Shete *et al*;2012, Amaral *et al*;2015 and Gurav *et al*;2016.[130,131,132]

Chronic Osteomyelitis

In a review of 21 cases of Chronic osteomyelitis by Malik & Singh in 2014, 14.28% cases were present in relation to mandibular incisors and 4.76% in relation to canine.[133] Another

case of osteomyelitis crossing the midline of mandible was reported by Patel *et al* in 2010.[134]

Table 1 Classification for radiolucencies crossing the midline of mandible

I.	**Tumors**
1.	Central Giant Cell Granuloma
2.	Odontogenic Myxoma
3.	Ameloblastoma
4.	Ameloblastic Carcinoma
5.	Ewings Sarcoma
6.	Osteosarcoma
7.	Adenomatoid Odontogenic Tumour
8.	Keratocystic Odontogenic Tumour
9.	Calcifying Cystic Odontogenic Tumor
10.	Chondrosarcoma
11.	Ghost Cell Odontogenic Carcinoma
12.	Dentinogenic Ghost Cell Tumor
13.	Intraosseous Carcinoma
II.	**Manifestations of Endocrine Disorders**
1.	Browns Tumor of Hyperparathyroidism
III.	**Manifestations of Fungal Infections**
1.	Mucormycosis
IV.	**Cysts**
A.	**Developmental**
1.	Dentigerous Cyst
2.	Median Anterior Mandibular Cyst
3.	Glandular Odontogenic Cyst
B.	**Inflammatory**
1.	Radicular Cyst
2.	Residual Cyst
V.	**Fibro-Osseous Disorders**
1.	Ossifying Fibroma
2.	Cemento-ossifying Fibroma
3.	Florid Cemento-Osseous Dysplasia
4.	Periapical Cemental Dysplasia
VI.	**Bone Disorders**
1.	Cherubism
VII.	**Idiopathic /Others**
1.	Traumatic Bone Cyst
2.	Aneurysmal Bone Cyst
3.	Chronic Osteomyelitis

CONCLUSION

Pathologies involving anterior mandibular region and associated literature review are rare compared to other sites.[3] Standard radiograph still being the most practiced primary investigation method,[2] this article, based on an extensive review of English literature provides a classification system for radiolucencies in the anterior mandible, crossing the midline of mandible, which will enable the dental/medical practitioner to narrow down the possible differential diagnosis, so as to formulate a specific treatment plan.

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