

Prevalence of Oral Maxillofacial Region Soft-tissue Calcification in Digital Panoramic Radiographs: A Retrospective Study

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Abstract

Aims and Objectives: The aim of the retrospective study was to find out soft-tissue calcification are often coincidentally diagnosed on maxillofacial region in digital panoramic radiographs. To estimate and compare soft-tissue calcification on male and female in various age groups also different site like right, left, and both in dental orthopantomograms. **Materials and Methods:** The collective digital panoramic radiographs of 1240 patients who visited dental collage of the oral radiology and medicine department, recorded data according to gender, age, and site. **Results:** The patient observed with soft-tissue calcification comprised phleboliths 0.4% of participants, antrolith in 1.1%, tonsillolith in 2.4%, calcified lymph nodes in 3.8%, stylooliths in 1.9%, and triticeous and thyroid cartilage calcification in 1.1%. The majority of participants (88.3%) did not exhibit any soft-tissue calcification, were present in 11.7% of participants, while 88.3% showed no calcification. This indicates that calcifications were relatively rare among the study population. **Conclusion:** Our study revealed that the soft-tissue calcification in maxillofacial region were right site more seen in female, young age group with calcified lymph node.

Keywords: Antrolith, Calcifications, Calcified lymph nodes, Calcinosis, Panoramic radiography, Phlebolith, Saliolith, Soft-tissue calcification, Stylohyoid, Thyroid cartilage, Tonsillolith and Triticeous.

INTRODUCTION

The deposition of calcium salt, calcium phosphate, usually occurs in the skeleton. When it occurs in an unorganized fashion in soft tissue, it is referred to as heterotopic calcification may develop in a wide variety of unrelated disorders and degenerative processes.^[1] When calcium salts are deposited in an unorganized in soft tissue, it is called heterotopic calcification, which is classified into three categories: metastatic, idiopathic, and dystrophic. When the serum levels of calcium or phosphate increase, minerals precipitate into normal tissue incite metastatic calcification.^[2,3] Which usually happen both side and symmetrically. However, idiopathic calcification occurs in soft tissues even when there are normal serum calcium and phosphate levels. Metastatic calcification results when the serum and body tissues have raised levels of calcium and phosphate this leads to precipitation of minerals into normal tissue. Hyperparathyroidism, hypercalcemia, or in malignancy serum calcium is increased or in chronic renal failure serum phosphate levels are increased.^[4,5] Metastatic calcification occurs bilaterally and symmetrically. Idiopathic calcification also called as calcinosis consequently in deposition of calcium in normal tissues with normal mineral balance.^[6]

Soft-tissue calcifications in the orofacial region are frequently detected as unexpected discovery during routine radiographic examinations with orthopantomograms (OPGs).^[7,8] The evaluation of such calcification should be carried out in a systematic manner considering the anatomical location, distribution, shape, size and number of calcifications to arrive at an appropriate diagnosis.^[9] Digital panoramic imaging is a routinely employed modality for diagnosing pathologies of the jawbones.^[10] There are various pieces of evidence available in the literature that delineates the detection of soft-tissue calcifications in OPG, but the prevalence of such calcinosis diverge widely among various studies and the population studied.^[11] The calcifications that can be encountered in panoramic radiographs include rhinoloth, antrolith, tonsillolith,

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phlebolith, sialolith, carotid artery calcifications, calcified lymph nodes, and stylohyoid ligament.^[12] With the increased utilization of digital panoramic imaging in routine dental practices, understanding of the soft-tissue calcifications and their characteristics are necessary for formulating a diagnosis and establishing an appropriate referral strategy.^[13,14]

The prevalence of soft-tissue calcifications is fairly common and these should be identified to differentiate innocuous lesions from pathologies. Hence, we felt the need to do retrospective study in collage (hospital department)-based study on prevalence of soft-tissue calcification in maxillofacial region on digital OPGs.

Intent and objective

1. To evaluate the prevalence of soft-tissue calcification seen in digital OPGs
2. To evaluate and compare the prevalence of calcifications in males and females, age group and site
3. To estimate incidence of most common soft-tissue calcification in which sex, age group, on which site in digital OPGs
4. To evaluate incidence of tonsillolith, sialolith, phlebolith, and lymph node, antrolith, stylohyoid ligament and triticeouse and thyroid cartilage soft-tissue calcifications seen in digital OPGs.

MATERIALS AND METHODS

Digital panoramic radiographs of 1240 dental patients who visited the oral medicine and radiology department from January 2022 to December 2024 were analyzed for soft-tissue calcification. Taken on Genoray papaya slim OPG X-ray machine(Korea), using Triana 2.5.9.OR2 the panoramic images were obtained from OPG machine with specifications like 68 kV, 9.0 Ma with 12 s of exposure time. The radiographs were of 659 males and 581 female's calcification were calcified according to the gender, age groups, and site. Age groups are divided in 30 years of groups such as young age (05–35 years), middle age (36–66 years), and old age (67–97 years). Each OPG radiographs was divided into nine boxes and six zone (1–6) as shown in Figure 1.

Statistical analysis

The data were tabulated into Excel spreadsheet and analyzed using the Statistical Packages for the Social Sciences software the arrangement of gender and age groups along with sites the relationship between gender and age groups and sites as well as clinical finding were analyzed using the Chi-square or Fisher's exact test. Statistical significant was evaluated as $P < 0.004$.

RESULTS

All the radiographs were taken in digital radiographic unit. The data were entered into Microsoft excel. Out of the 1240 patients whose radiographs were viewed for evidence of calcification, the number of radiographs with evidence of calcification was 145 (11.7%) (Table 1).

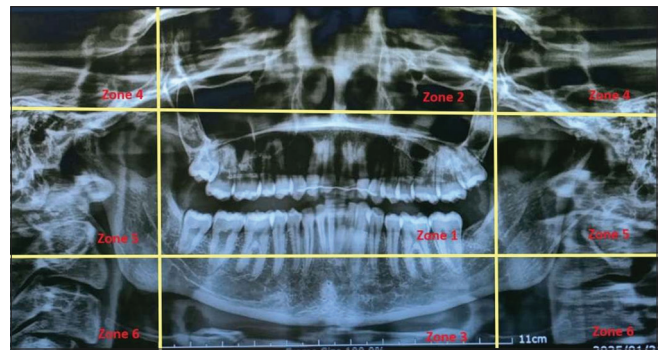


Figure 1: Segmentation of orthopantomograms to identify soft-tissue calcifications

Among, individuals with soft-tissue calcification phleboliths were observed in 0.4% of participants, antrolith in 1.1%, tonsilloliths in 2.4%, calcified lymph nodes in 3.8%, stylohyoid ligament calcification in 1.0%, sialoliths in 1.9%, and triticeous and thyroid cartilage calcification in 1.1%. The majority of participants (88.3%) did not exhibit any soft-tissue calcification (Figure 2). This indicates that calcification were relatively rare among the study population (Table 2). The gender distribution of participants was fairly balanced, with males constituting 53.1% of the sample and females accounting for 46.9% (Figure 3). This equitable representation ensures a reliable comparison between genders in analyzing the prevalence patterns of soft-tissue calcifications. Out of 145 individuals exhibiting soft-tissue calcification 62 (9.5%) male and 83 (14.3%) were female.

In the study, the age distribution of participants was as follows: 35.7% were in the young age group (5–35 years), 31.3% were middle-aged (36–66 years), and 33.0% were in the old age group (67–97 years). This fairly even distribution across age categories supports an age-wise analysis of the prevalence of different types of soft-tissue calcifications (Figure 4).

The evaluation of calcification site base in the study, the distribution of soft-tissue calcifications based on site was as follows: 5.2% were observed on the right side, 3.4% on the left side, 3.1% on both sides, and 88.3% showed no calcifications. This highlights that the majority of participants did not exhibit soft-tissue calcifications, with a smaller proportion having site-specific occurrences (Figure 5) This indicates that calcifications were relatively rare among the study population. In the study, soft-tissue calcifications were present in 11.7% of participants, while 88.3% showed no calcifications (Figure 6).

DISCUSSION

In our study we noticed soft-tissue calcification in 11.7% of total radiographs which comparatively lower than the reports of previous studies Darwin *et al.* which revealed a prevalence rate 12.9%.^[15] This contrast in the prevalence can be attributed to several factors such as racial, age, geographical variations. Aside from, the possibility to alter the image density and contrast in the radiographic images can also attribute to the

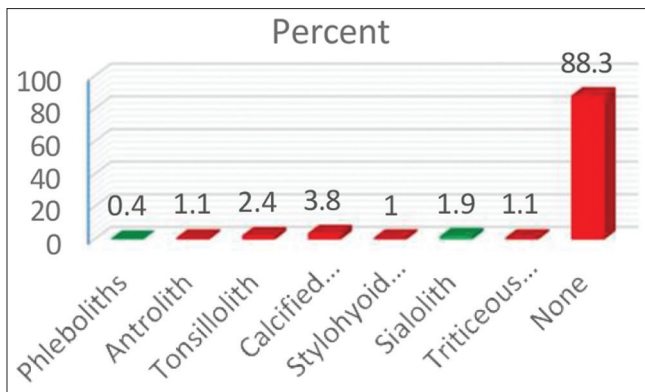


Figure 2: Type of soft-tissue calcification

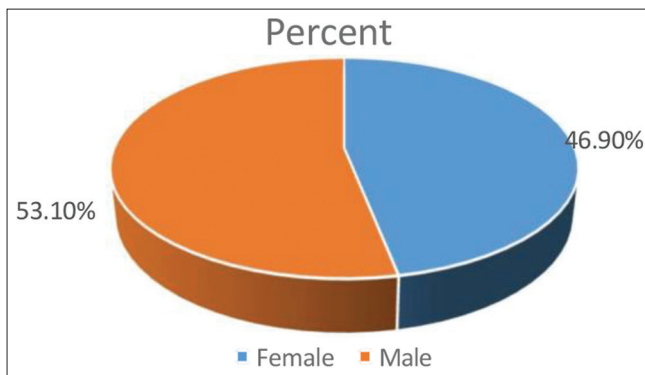


Figure 3: Gender distribution

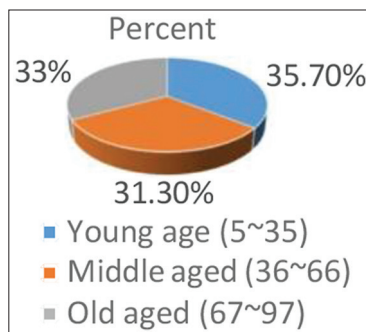


Figure 4: Soft-tissue calcification according to age

variations as reported by Monsour *et al.*^[16] We found that the majority of calcifications within the soft tissues were more common in younger age (5–35 years) 15.3%, than middle age (36–66 years) 13.6% population followed by old age (67–97 years) 5.6%. Findings were consistent with the results of Icoz and Akgunlu^[17] and Ribeiro *et al.*^[18] who also suggested that the prevalence of calcifications increased above 40 years (Tables 3-5).

Of the total radiographs examined, 05 (0.4%) of the radiopacities represented the characteristic features of phleboliths, which are the calcifications of the venous system. Similar findings were reported by Saati *et al.* who observed a prevalence rate of 0.29% of phleboliths.^[19] According to our study phleboliths seen in female younger age (05–35 years)

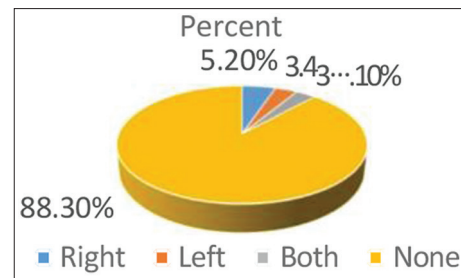


Figure 5: Calcifications according to site

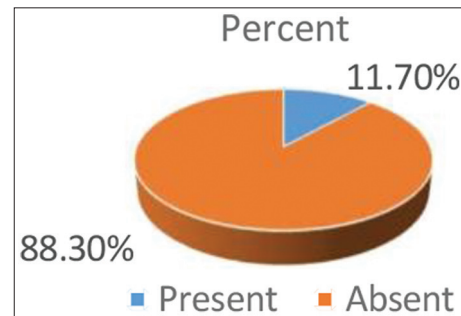


Figure 6: Presence of calcification

right side. The prevalence of antrolith, observed in our study was 1.1% and most of them were found on the right side. In our study, the occurrence of antroliths was more in the middle age (36–66 years) males. These results were found to be significant and was similar to the findings of Ribeiro *et al.*^[18]

In our study, tonsilloliths constituted 2.4% of the total included radiographs. Our findings can be matched with the reports by Darwin *et al.* who reported prevalence rates of 1.3% respectively.^[15] Occurrence of tonsilloliths in the right side were significant in males which is consistent with the findings reported by Saati *et al.*^[19] In our study tonsilloliths are common in females young age (5–35 years) both side.

Of the study calcified lymph node seen in more females young age (05–35) on right side. A prevalence rate of calcified lymph node is 3.8%. The majority of calcification were found in the young age group, though older participants showed higher rate of specific calcifications like calcification like calcified lymph nodes. Prevalence of the stylohyoid ligament is 1.0% in our study. We observed the incidence of calcified stylohyoid process to be significantly higher in women and predominantly on the right side compared to the left (Table 5). Our findings are in according with the study by Guimarães *et al.* and Öztaş and Orhan which eported patients above 40 years of age to have higher occurring of calcification of the stylohyoid complex.^[20,21] Its only varied by age group. El Deeb *et al.* reported that sialolithiasis affects 0.01–1% of the population,^[22] which is compatible with our results, as we found sialoliths in 1.9% of the participants. Sailoliths mostly seen our study in males with young age group (05–35) on left side of the study triticeous and thyroid cartilage more common in female (1.9%) compare to male (0.5%). Prevalence rate of 1.1%.

AQ7 **Table 1: Definition of soft-tissue calcification, radiographic features, and location in radiograph**

Calcification	Definition	Location	Radiographic features
Phlebolith	Calcification of intravascular thrombus	The parotid gland is the major site of vascular malformation that affect the salivary glands (seen in zone 5 right and left side)	Round and oval shape and measure up to 6 mm in diameter with smooth periphery, may resemble a straight or slightly curved sausage Bull's eye or target-like appearance
Antrolith	Calcified bodies within the antral/nasal cavity	In the maxillary sinus, typically between the nasal septum and inferior turbinate (seen in zone 2)	Homogeneous or heterogeneous radiopacities depending on the nature of nidus
Tonsillolith	Calcified tonsil within enlarged tonsillar crypts	Due to the angulation of panoramic X-ray projection, tonsillolith can observed in different regions including along the inferior two-thirds of the mandibular ramus; overlap either with in anterior or posterior of the ramus; posteroinferior to the angle of the mandible (seen in zone 5 right and left side)	Usually appear as either multiple clusters of irregular radiopacities or as a solitary round radiopaque structure
Calcified lymph nodes	A complex component of the immune system including cervical submandibular, submental, and preauricular lymph nodes	Nearly half of all peripheral lymph nodes are located deep in the subcutaneous tissue in the head and neck (seen in zone 5 and 6 both side).	Cauliflower appearance multiple and irregular mostly seen in submandibular region and inferior to the angle of mandible
Stylohyoid	Elongated stylohyoid process and all type of ossified stylohyoid ligament together are referred to as ossified stylohyoid complex	The bone and ligament complex that extends from the base of the temporal bone styloid process to the lesser horn of the hyoid bone (seen in zone 4 both side)	Variation of the stylohyoid complex various lengths of stylohyoid process
Sialolith	Calcified mass within a salivary gland	Submandibular stone above and below the body as well as mesial to the mandibular angle parotid stone in the upper third of the ramus or located behind the lower third of the ramus or behind the angle mandible (Seen in zone 5 both sides)	Unilateral solitary or multiple as diffuse, homogeneous, uniformly calcified radiopacities with regular contours it large showing multiple layers of calcification
Tricaceous and thyroid cartilage	A condition where a small cartilage in laryngeal skeleton become calcified (c3-c4)	Within the thyrohyoid ligament between the greater horn of the hyoid bone and the superior horn thyroid cartilage (Seen in zone 6 right and left side)	When calcified appears as mostly oval with smooth edges, with well- defined cortical margins at the level of c3-c4.

Table 2: Frequency of various soft-tissue calcification

Soft tissue calcification	Type of soft-tissue calcification			
	Frequency	Percent	Valid percent	Cumulative percent
Phleboliths	5	0.4	0.4	0.4
Antrolith	14	1.1	1.1	1.5
Tonsillolith	30	2.4	2.4	4.0
Calcified lymph nodes	47	3.8	3.8	7.7
Stylohyoid ligament	12	1.0	1.0	8.7
Sialolith	23	1.9	1.9	10.6
Tricaceous and Thyroid cartilage	14	1.1	1.1	11.7
None	1095	88.3	88.3	100.0
Total	1240	100.0	100.0	

Distribution of soft-tissue calcifications by gender

The distribution of soft-tissue calcifications varied between males and females: Females shows higher percentages of tonsilloliths (2.9%), calcified lymph nodes (5.0%), and tritaceous and thyroid cartilage calcification (1.9%). A majority (85.7%) of females exhibited no calcifications. Males, in contrast, had higher percentages of antroliths (1.4%), sialoliths (2.1%), and a larger proportion (90.6%) with no calcifications. The Pearson Chi-Square value is 19.363, with a $P = 0.007$, indicating a statistically significant association between gender and the type

of soft-tissue calcification. This suggests that the distribution of calcification types is not random across genders. The Cramer's V value is 0.125, with a significance level of 0.007. This indicates a small but statistically significant strength of association between gender and the type of soft-tissue calcifications. The study found a statistically significant association between gender and the type of soft-tissue calcifications, with differences observed in the prevalence of specific calcification types between males and females. However, the strength of this association is small, as indicated by Cramer's V.

Table 3: Type of soft-tissue calcification according to age

Crosstab									
Age of patient	Type of soft-tissue calcification								Total
	Phleboliths	Antrolith	Tonsillolith	Calcified lymph nodes	Stylohyoid ligament	Sialolith	Triticeous and thyroid carriage	None	
Young age (5~35)									
Count	4	5	11	26	5	11	6	375	443
% within age of patient	0.9	1.1	2.5	5.9	1.1	2.5	1.4	84.7	100.0
Middle aged (36~66)									
Count	1	6	15	12	4	10	6	334	388
% within age of patient	0.3	1.5	3.9	3.1	1.0	2.6	1.5	86.1	100.0
Old aged (67~97)									
Count	0	3	4	9	3	2	2	386	409
% within age of patient	0.0	0.7	1.0	2.2	0.7	0.5	0.5	94.4	100.0
Total									
Count	5	14	30	47	12	23	14	1095	1240
% within age of patient	0.4	1.1	2.4	3.8	1.0	1.9	1.1	88.3	100.0

Table 4: Type of soft-tissue calcification according to gender

Crosstab									
Gender	Type of soft-tissue calcification								Total
	Phleboliths	Antrolith	Tonsillolith	Calcified lymph nodes	Stylohyoid ligament	Sialolith	Triticeous and Thyroid cartriage	None	
Female									
Count	5	5	17	29	7	9	11	498	581
% within Gender	0.9	0.9	2.9	5.0	1.2	1.5	1.9	85.7	100.0
Male									
Count	0	9	13	18	5	14	3	597	659
% within Gender	0.0	1.4	2.0	2.7	0.8	2.1	0.5	90.6	100.0
Total									
Count	5	14	30	47	12	23	14	1095	1240
% within Gender	0.4	1.1	2.4	3.8	1.0	1.9	1.1	88.3	100.0

Distribution of soft-tissue calcifications by age

Young age (5–35 years): 84.7% of participants in this age group had no calcifications, with the remaining 15.3% exhibiting various types of calcifications, such as tonsilloliths (2.5%) and calcified lymph nodes (5.9%). Middle -aged (36–66 years): 86.1% had no calcifications, and the rest showed various types, with tonsilloliths (3.9%) and sialoliths (2.6%) being most common. Old age (67–97 years): 94.4% had no calcifications, with a smaller percentage having calcified lymph nodes (2.2%) and tonsilloliths (1.0%).

The Pearson Chi-Square value is 32.304, with a $P = 0.004$, indicating a statistically significant association between age and the type of soft-tissue calcifications. This suggests that the distribution of calcifications varies significantly with age. The Cramer's V value is 0.114, with a significance level of 0.004. This indicates a small but statistically significant strength of

association between age and the type of soft-tissue calcifications. The study found a statistically significant association between age and the type of soft-tissue calcifications, with the frequency of calcifications increasing with age. However, the strength of the association is small, as indicated by Cramer's V. The majority of calcifications were found in the younger age group, though older participants showed higher rates of specific calcifications like calcified lymph nodes.

Distribution of soft-tissue calcifications by site

Right side

6.2% of participants with calcifications had phleboliths, 15.4% had antroliths and tonsilloliths each, 35.4% had calcified lymph nodes, and the remaining types of calcifications were observed in smaller percentages. No participants had calcifications on the right side without any specific type.

Table 5: Statically analysis of soft-tissue calcification by site

Site	Type of soft-tissue calcification							Total
	Phleboliths	Antrolith	Tonsillolith	Calcified lymph nodes	Stylohyoid ligament	Sialolith	Triticeous and thyroid carriage	
Right								
Count	4	10	10	23	5	6	7	65
% within Site	6.2	15.4	15.4	35.4	7.7	9.2	10.8	100.0
Left								
Count	1	2	9	12	3	11	4	42
% within Site	2.4	4.8	21.4	28.6	7.1	26.2	9.5	100.0
Both								
Count	0	2	11	12	4	6	3	38
% within Site	0.0	5.3	28.9	31.6	10.5	15.8	7.9	100.0
None								
Count	0	0	0	0	0	0	0	1095
% within Site	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Total								
Count	5	14	30	47	12	23	14	1240
% within Site	0.4	1.1	2.4	3.8	1.0	1.9	1.1	88.3

Left side

2.4% had phleboliths, 4.8% had antroliths, 21.4% had tonsilloliths, 28.6% had calcified lymph nodes, and sialoliths (26.2%) were the most prevalent calcification type. No left-side calcifications were without a specified type.

Both sides

0% had phleboliths, but 5.3% had antroliths, 28.9% had tonsilloliths, and 31.6% had calcified lymph nodes. Other calcifications occurred at lower frequencies.

None: The majority of participants (88.3%) showed no calcifications. The Pearson Chi-Square value is 1364.181, with a $P = 0.000$, indicating a highly significant association between the site and the type of soft-tissue calcification. This suggests that the occurrence of different types of calcifications is dependent on the site. The Cramer's V value is 0.606, with a significance level of 0.000. This indicates a strong association between the site and the type of soft-tissue calcification.

The study found a statistically significant and strong association between the site of calcifications (right, left, both, or none) and the type of soft-tissue calcifications. The majority of calcifications were found in specific sites, with tonsilloliths and calcified lymph nodes being common. The strength of this association is high, as indicated by the Cramer's V value of 0.606.

El Deeb *et al.*^[22] done this study with help of cone beam computerized tomography (CBCT) and they found that Eight hundred and eighty-two soft-tissue calcifications were detected in 626 (62.6%) patients. MM-field of view (MM-FOV) presented the highest prevalence (76.8%), followed by MD-FOV (60.6%) and MX-FOV (57.2%). ESP and tonsillolith were the most frequent calcifications. Calcifications requiring treatment or not and those in need of follow-up accounted for 6.9%, 92.7%, and 0.3% of cases, respectively. There was no association between

calcifications and subjects' gender or age ($P > 0.05$). Most cases of ESP occurred bilaterally and were longer in males ($P < 0.05$). CBCT, intraoral scanner and 3D printer had changed many things in diagnosis and treatment in dentistry.^[23-32]

This study has certain limitations which includes

1. This study cannot be continued as the patient follow up is challenging, and all findings are incidental, observed within a specific time frame
2. OPGs produce a two-dimensional image, which may not accurately represent the three-dimensional nature of calcifications. This can lead to distortions or misinterpretations of the size, shape, and exact location of calcified structures
3. The gaps in a patient's complete medical history stems from a lack of consistency in criteria for soft-tissue calcification analysis on panoramic radiographs.

CONCLUSION

The identification and description of the clinical effects of symptomatic and asymptomatic patients with specific calcifications and their clinical impacts requires further, well-structured multi-centric prospective longitudinal studies with a focus on 3D radiographic techniques. Such studies would not only improve the quality of healthcare delivery for every individual but also ensure appropriate referrals to mitigate potential morbidities.

Present study showed that soft-tissue calcification is a relatively common finding in OPG radiographs. We found soft-tissue calcification more in female patients' occurrence in young age group on right site such as calcified lymph nodes, tonsilloliths. This eventually improve the prognosis of the disease. The anatomical location, site, gender and type of the calcifications

are important diagnostic criteria in radiographic evaluation of soft-tissue calcification.

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