

Prevalence Of Soft Tissue Calcifications On Digital Orthopantamograph – A Retrospective Study

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Abstract

Background: The identification of soft tissue calcification of the head and neck area is crucial for diagnosing systemic diseases, identifying the presence of asymptomatic pathologies and designing effective treatment. These calcifications can be a sign of underlying disorders like vascular, metabolic and infectious disorders. The present study was done to determine the prevalence of detectable soft tissue calcifications in head and the neck regions through digital panoramic radiographs.

Materials and Methods: A total of 3,902 digital panoramic radiographs of adult male and female patients who attended a dental hospital were examined by qualified Oral and Maxillofacial Radiologists. These calcifications were divided into many types, such as calcified stylohyoid ligament, phleboliths, calcified vessels, sialoliths and tonsilloliths.

Results: Among the identified calcifications, the calcified stylohyoid ligament showed the highest prevalence at 67.4%. Parotid gland calcifications accounted for 13.4%, followed by atheromatous plaques (9.4%), sialoliths (4.0%), and calcified lymph nodes and tonsilloliths (1.1% each).

Conclusions: Digital panoramic radiographs are very useful in identifying soft tissue calcifications in head as well as neck region. Results showed that most common were the calcifications of the stylohyoid ligaments, then parotid gland calcifications and atheromatous plaques. These findings highlight the importance of radiographic assessments in the early detection and treatment of underlying systemic or localized diseases.

Keywords: Digital Orthopantamograph, Sialoliths, Soft tissue calcifications, Stylohyoid ligament calcifications.

1. Introduction

Calcium, one of the most essential micronutrients for the human body, serves crucial role in development and maturation of bones, teeth, and also in the blood coagulation pathway. Pathological soft tissue calcifications occur when calcium, particularly calcium phosphate, is deposited in tissues in an unorganized manner, a condition known as heterotopic calcification. These calcifications appear as radiopacities on radiographs. These radiopacities are observed in approximately 4% of orthopantamographs (OPG). (1)

Heterotopic calcifications are classified into 3 groups.

1. Metastatic calcification - denotes deposition of calcium salts in otherwise healthy tissues due to elevated serum calcium levels.
2. Dystrophic calcification – implies to deposition of calcium in disintegrated or necrotic tissues. Calcium deposition in degenerated tissues or necrotic tissues.
3. Idiopathic calcinosis - refers to calcium deposition in subcutaneous tissues with no identifiable metabolic cause. (2)

Soft tissue calcifications in neck and head area could be classified into the following categories:

Table 1: Classification of Soft Tissue Calcifications in the Head and Neck Region

1	Dystrophic calcification	• Cysticercosis • Dystrophic calcification in the tonsil • Calcified lymph nodes • Arterial calcification - Monckeborg's medial calcinosis (arteriosclerosis) ▪ Calcified atherosclerotic plaque
2	Metastatic calcifications	• Ossification of the stylohyoid ligament • Myositis ossificans • Osteoma cutis
3	Idiopathic calcifications	• Rhinolith/Antrolith • Sialoliths • Laryngeal cartilage calcifications • Phleboliths

Antrolith is calcified mass typically observed in maxillary sinus. This may present with varying symptoms, often associated with chronic sinusitis. Common symptoms include nasal obstruction, foul-smelling postnasal drip, otorrhea, cacosmia (difficulty identifying smells), and halitosis.

Calcified lymph nodes appear as radiopaque calcifications typically located along inferior border of mandible, most commonly nearby mandibular angle. They are typically asymptomatic and commonly affect superficial cervical, submandibular, deep cervical lymph nodes.

The calcified stylohyoid ligament typically appears bilaterally, though unilateral calcifications while rare, can occur. It appears as linear ossifications extending from the lower edge of the mastoid process, along lower border of mandible, to hyoid bone. These calcifications are believed to result from post-tonsillectomy scarring or trauma. Eagle's syndrome, associated with an elongated stylohyoid ligament, manifests as symptoms such as dysphagia, dysphonia, cough, sore throat, facial pain, and vertigo.

Carotid artery calcifications appear as radiopaque structures typically located between the C3 and C4 cervical vertebrae. These calcifications are closely linked to a higher risk of cardiovascular complications. Timely referral of affected patients is essential to reduce risk factors and prevent additional health issues.

Phleboliths are calcified thrombi that typically develop from blood stagnation and thrombosis within venous malformations. Depending on their size and location, they can lead to intermittent or persistent swelling and discomfort.

Tonsilloliths are hard, often painful, buildups of debris as well as bacteria that become lodged in crevices of the tonsils. Symptoms may include a persistent cough, sore throat, and an unpleasant taste. While they typically occur unilaterally, bilateral cases have also

been reported. Proper identification of these calcifications requires comprehensive knowledge, anatomical expertise, and clinical experience.

Research carried out by Maia PRL et al. on occurrence of soft tissue calcifications in elderly individuals found that 43% of participants had at least one form of soft tissue calcification. The most commonly detected calcifications included carotid artery calcifications (CAC), tonsilloliths, sialoliths, thyroid and triticeous cartilage calcifications, calcified lymph nodes, phleboliths. The study also found a significant correlation between female gender and availability of thyroid as well as triticeous cartilage calcifications, among males, presence of tonsilloliths.[3]

2. Materials and Methods

In 3,902 patients of both sexes, aged between 11 and 90yrs, digital panoramic radiographs have been analyzed in Department of Oral Medicine and Radiology during 2023-24. These radiographs were referred from various dental specialties to the Oral Radiology department. Among the 3,902 radiographs, 1,869 were from male patients and 2,033 from female patients.

Panoramic images have been attained using a panoramic radiographic system (Planmeca ProMax) with exposure settings of 66kVp, 8mA, exposure time of 15.8 seconds. The radiographs were reviewed on an 18-inch monitor by an experienced radiologist on 2 separate occasions, with 30-day interval among observations to ensure reliability.

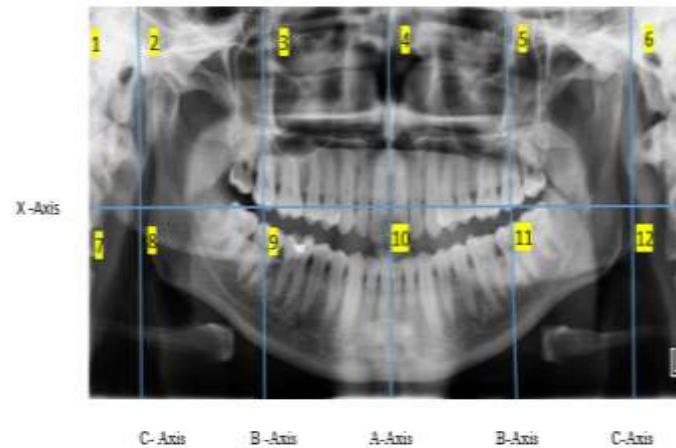
Calcifications were categorized based on their site, number, and distribution. For ease of interpretation, the panoramic radiograph was divided into 12 imaginary sections, numbered 1 through 12, as per a standardized reference points and anatomy with midpoint between boxes 3 and 4 coinciding with midline (Axis – A), line passing through long axis of 2nd maxillary molar (Axis – B) on both sides, line passing adjacent to posterior wall of the ramus (Axis-C) on both sides and a horizontal line passing through mandibular ramus coinciding the cemento enamel junction(CEJ) of the central incisors (Axis – X).[4].(figure:1)

Classification of Calcifications

1. **Calcified Stylohyoid Ligament:** Identified as a linear ossification extending from the inferior border of the mastoid process, along the inferiolateral border of the mandible, to the hyoid bone. It is typically observed spanning boxes 1–8 or boxes 6–11.
2. **Antrolith:** Classified as an antrolith if the calcification is located within the maxillary sinus antrum and appears in either the 3rd or 4th box.
3. **Rhinolith:** Recognized as a calcification in the nasal fossa adjacent to the nasal septum, on the medial aspect, and observed in the 3rd or 4th box.
4. **Tonsillolith:** Identified as unilateral or bilateral radiopacities clustered near the oropharyngeal space, typically observed in the 2nd or 5th, sometimes in the 8th or 11th boxes near the mandibular angle region.
5. **Calcified Vessels:** Classified as atheromatous plaque if seen as a streak or parallel pair of radiopaque lines or irregular radioopacity involving either the facial or carotid artery, located adjacent to the cervical spine (C3-C4) in the 7th or 12th box.
6. **Phlebolith:** Identified as multiple tiny concentric rings with alternating radiolucent and radiopaque areas, typically located in the 8th or 11th box.
7. **Sialolith:** calcifica of the submandibular gland if it appears as a smooth, cylindrical calcification in the duct or as irregular, larger calcifications at the hilus, typically observed in 8th and 11th boxes and if sialolith located in parotid gland it appears a single radioopaque mass or cluster of small radiopacities in 2nd or 5th boxes.

- 8. Calcified Lymph Node:** Identified as a calcified lymph node when it appears as a well-defined structure with an irregular periphery and a lobulated surface, typically appearing as a cauliflower, located in the 8th or 11th boxes

Figure:1 Showing orthopantomograph with 12 boxes for site-specific analysis



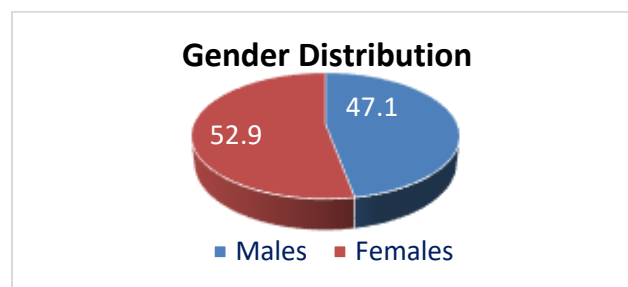
3. Results

All the panoramic radiographs were taken using planmeca digital OPG machine. All the radiographs were analyzed by an experienced radiologist and analyzed. Statistics were completed using SPSS software. Total 3902 Digital Panoramic images of both sexes of different age groups ranging from (11-90) were analyzed. Out of 3902 radiographs, 1869 belong to males and 2033 belong to females. The average age of patients has been 45 years ± 10 years. Out of 3902 radiographs examined for soft tissue calcifications, 276 radiographs (7.07%) were found to have calcifications. Out of 276 radiographs 130 were males (47.1%) and 146 were females (52.9%) [graph 1, table 2]. These calcifications are not significant for any gender group [Table 4]. Prevalence of calcifications in different age groups was analyzed. There is significant difference in terms of age distribution of calcifications with a p value of 0.001 (p value < 0.001). 3 to 5 decades have been found to have a greater number of calcifications. [Table 5]

Table 2: Gender Distribution of Soft Tissue Calcifications

		<i>Frequency</i>	<i>Percent</i>
Gender	Males	130	47.1
	Females	146	52.9
	Total	276	100.0

Graph 1: Gender wise distribution of soft tissue calcifications



Out of 276 radiographs, 189 were calcified stylohyoid ligament (68.4%) (Figure 2), 37 were parotid gland calcifications (13.7%) (Figure 3), 27 were atheromatous plaques (9.7%), 16 submandibular gland sialoliths (5.8%) (Figure 4), 4 tonsilloliths (1.4%), 3 calcified lymph nodes (1.1%) were identified [Graph 2, Table 3].

Figure 2: Elongated calcified styloid process on right side extending from box 1 to 8

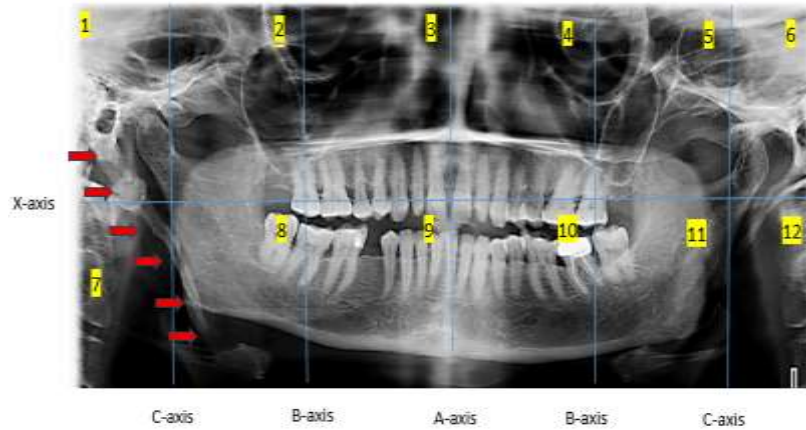


Figure 3: Sialolith in the parotid gland on right side located in box 2

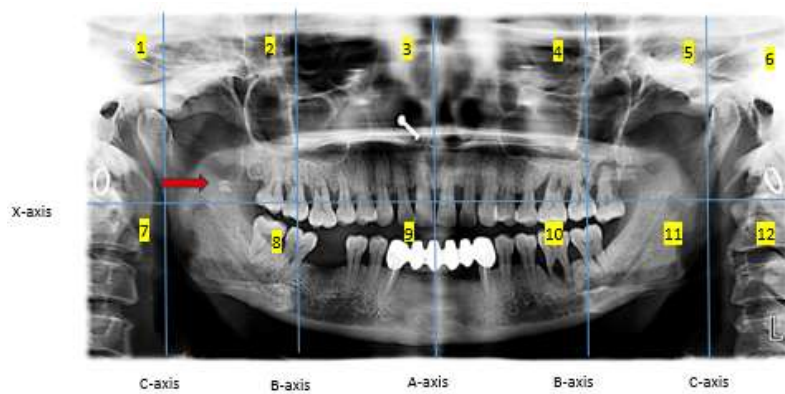


Figure 4: Sialolith in the submandibular salivary gland on right side located in box 11

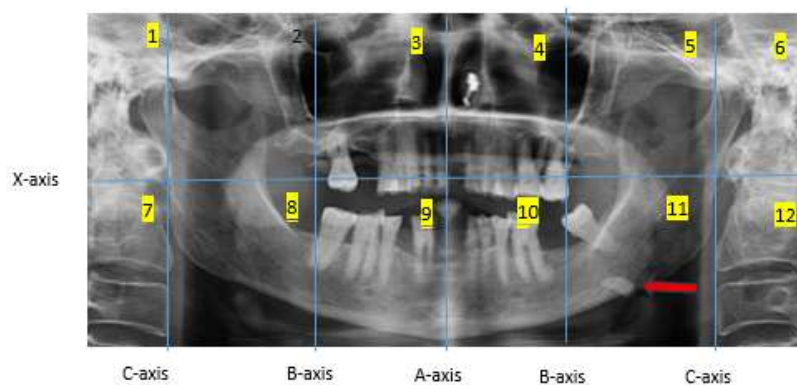
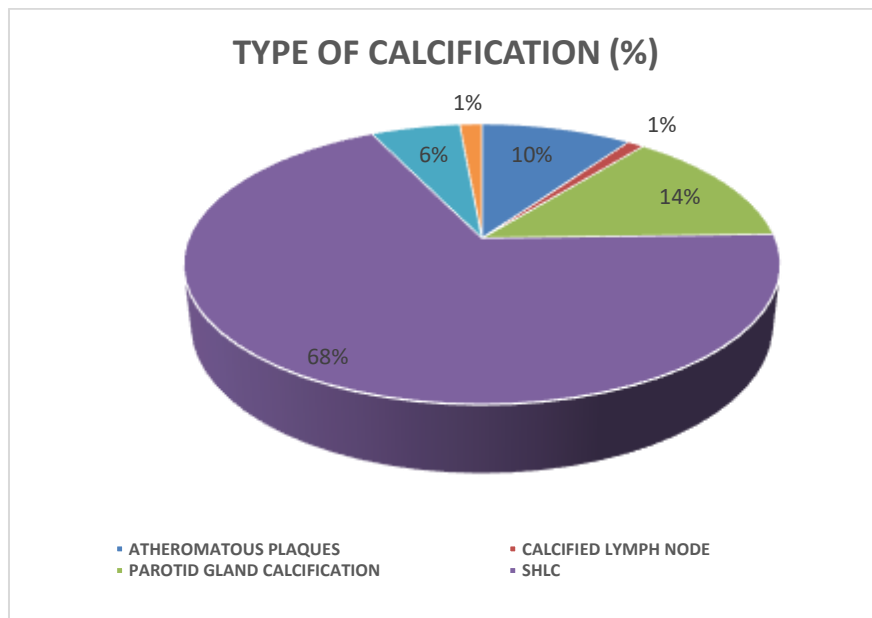


Table 3: Type and frequency of soft tissue calcifications

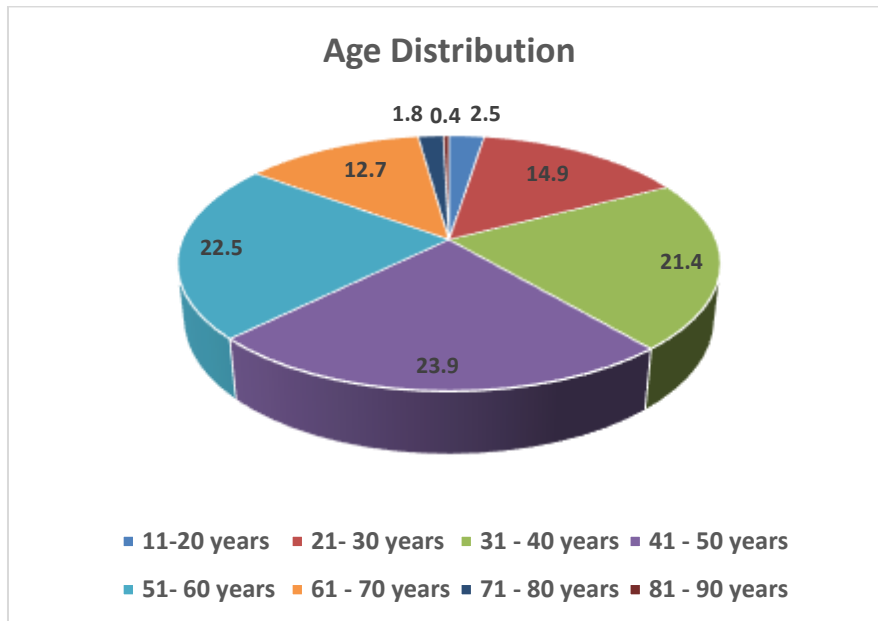
Types	Frequency	Percent
Atheromatous Plaques	27	9.7
Calcified Lymph Node	3	1.1
Parotid Gland Calcification	37	13.7
calcified stylohyoid ligament	189	68.4
Sialolith	16	5.8
Tonsillolith	4	1.4
Total	276	100.0

Graph 2: Distribution of soft tissue calcifications based on type

The age distribution along with frequency of soft tissue calcifications was classified between the ages of 11 and 90 years (Table 4, Graph 3). Out of 276 calcifications, the majority, 187 (67.8%), were discovered in age ranges 31-60.

Table 4: Age Distribution of soft tissue calcifications

		Frequency	Percent
Age	11 to 20 years	7	2.5
	21 to 30 years	41	14.9
	31 to 40 years	59	21.4
	41 to 50 years	66	23.9
	51 to 60 years	62	22.5
	61 to 70 years	35	12.7
	71 to 80 years	5	1.8
	81 to 90 years	1	.4
Total		276	100.0

Graph 3: Age-wise distribution study sample

These calcifications are not significant for any gender group [Table 5]. Prevalence of calcifications in different age groups was analyzed. There is significant difference in terms of age distribution of calcifications with a p value of 0.001 (p value < 0.001). 3 to 5 decades found to have a greater number of calcifications

Table 4: Statistical analysis of soft tissue calcifications according to gender.

Type of Calcification		Gender		Total	Chi-Square Value	P Value
		Males	Females			
Atheromatous Plaques	Count	9	18	27	16.97	0.10*
	% Of Total	3.2%	6.5%	9.7%		
Calcified Lymph Node	Count	2	1	3		
	% Of Total	0.7%	0.4%	1.1%		
Parotid Gland Calcification	Count	25	12	37		
	% Of Total	9.7%	4.0%	13.7%		
SHLC	Count	83	106	189		
	% Of Total	30%	38.4%	68.4%		
Sialolith	Count	9	7	16		
	% Of Total	3.5%	2.3%	5.8%		
Tonsillolith	Count	2	2	4		
	% Of Total	0.7%	0.7%	1.4%		
Total	Count	130	146	276		
	% Of Total	47.1%	52.9%	100.0%		

Statistical test applied: Chi-square test; *Non-significant

Out of 189 stylohyoid ligament calcifications (Figure 2) highest calcifications i.e. 52(18.8%), were found between 31 to 40 years 43 (15.5%) calcifications between 41-50 years. Out of 37 parotid calcifications highest calcifications i.e. 16(5.8%) calcifications were found between 51-60 years. Out of 27 calcified atheromatous plaques highest calcifications i.e. 9(3.2%) are were noted in between 41-50 years, 8(2.9%) between 61-70 and 5(1.8%) between 51-60. Out of 16 sialoliths of submandibular salivary gland calcifications 5(1.8%) were noted in 51-60 age group. Out of 4 tonsilloliths 2 (0.7%) were noted between 41-50 age group [Table 6]

Table 5: Statistical analysis of soft tissue calcifications according to age.

Type_of_calcification		Age								Total	Chi square value	P value
		11-20 years	21-30 years	31-40 years	41-50 years	51-60 years	61-70 years	71-80 years	81-90 years			
Atheromatous Plaques	Count	0	1	4	9	5	8	0	0	27	179.08	0.000*
	% Total	0.0%	0.4%	1.4%	3.2%	1.8%	2.9%	0.0%	0.0%	9.7%		
Type_of_calcification		Age								Total	Chi square value	P value
		11-20 years	21-30 years	31-40 years	41-50 years	51-60 years	61-70 years	71-80 years	81-90 years			
Calcified Lymph Node	Count	0	1	0	1	0	1	0	0	3	179.08	0.000*
	% Total	0.0%	0.4%	0.0%	0.4%	0.0%	0.4%	0.0%	0.0%	1.1%		
Parotid Gland Calcification	Count	0	2	1	11	16	6	1	0	37		
	% Total	0.0%	0.7%	0.4%	4.0%	5.8%	2.2%	0.4%	0.0%	13.7%		
Shlc	Count	6	33	52	43	36	16	3	0	189		
	% Total	2.2%	12.0%	18.8%	15.5%	13.0%	5.8%	1.1%	0.0%	68.4%		
Sialolith	Count	1	3	2	2	5	2	1	0	16		
	% Total	0.4%	1.1%	0.7%	0.7%	1.8%	0.7%	0.4%	0.0%	5.8%		
Tonsillo lith	Count	0	0	0	2	0	1	0	1	4		
	% Total	0.0%	0.0%	0.0%	0.7%	0.0%	0.4%	0.0%	0.4%	1.4%		
Total		7	41	59	66	62	35	5	1	276		

Type_of_calcification	Age								Total	Chi square value	P value
	11-20 years	21-30 years	31-40 years	41-50 years	51-60 years	61-70 years	71-80 years	81-90 years			
% Total	2.5%	14.9%	21.4%	23.9%	22.5%	12.7%	1.8%	0.4%	100%		

Statistical test applied: Chi square test; *Highly significant at $p < 0.01$

4. Discussion

Panoramic radiographs provide a comprehensive view of maxilla, mandible, other craniofacial structures in a single image with minimal radiation exposure to the patient. This is an imaging method that gives a general evaluation of the dentition and periodontal condition and is therefore a popular diagnostic method used by dentists.

The soft tissue calcifications are often incidentally observed on panoramic radiographs, because they are typically asymptomatic. This imaging tool is regarded as one of the tools that are most effective in detection of calcifications in neck or head region. Typical soft tissue calcifications seen are the styloid ligament calcifications, sialoliths, atheromatous plaques and calcified lymph nodes.

Panoramic radiographs are essential in the diagnosis and treatment of underlying conditions and possible complications by facilitating the early identification of such calcifications.

Our research has shown a prevalence of soft tissue calcifications 7.07 which is somewhat less than prevalence of 8% in study by Janisha Vengalath et al. (2014) [4].

The primary calcifications identified in our study included atheromatous plaques, calcified lymph nodes, tonsilloliths, parotid gland calcifications, stylohyoid ligament calcifications, and sialoliths.

Constantine S performed a study of incidental carotid artery calcifications (CAC) identified on radiographs and found that the presence of CAC on orthopantomograms (OPGs) could represent a critical carotid artery stenosis and a high risk of stroke. In their study, they found the CAC prevalence of 10.8%. Our study on the other hand reported a prevalence of 7.07% [5].

According to Brito et al., age has been important parameter in development of CAC as majority of these cases were observed in the elderly. In line having findings of their study, our study indicated that most of the CAC cases were detected in persons aged between 41 and 70 years [6]. Similarly, Vengalath et al., in their evaluation of 1615 panoramic radiographs across various age groups, observed that women over 45 years of age had a higher prevalence of CAC. Likewise, in our research, prevalence of CAC has been observed to be higher in women [Graph 5].

In our study, elevated occurrence of soft tissue calcifications has been observed for stylohyoid ligament calcifications (68.4%), aligning with the findings of Javadzadeh Haghighat AS et al., who stated prevalence of 30.7% for stylohyoid ligament calcifications, followed by tonsilloliths [7]. Similarly, in our study, stylohyoid ligament calcifications were the most common, followed by parotid gland calcifications.

In a retrospective study on sialoliths in OPG conducted by Aoun G et al. in 2020, it was found that submandibular gland sialoliths were more common than parotid gland sialoliths. However, in our study, parotid gland calcifications were more prevalent than submandibular gland calcifications. Among the 276 soft tissue calcifications identified, 37 (13.7%) were sialoliths in the parotid gland, while 16 (5.8%) were in the submandibular gland.

Additionally, Aoun G et al. noticed increased prevalence of sialoliths in females compared to males. Conversely, we have observed that sialoliths were more common in males than in females [8].

Tonsilloliths also called tonsil stones or calculi are groupings of calcifications forming in enlarged tonsillar crypts, in tonsils or near tonsils, normally through chronic inflammation. Incidentally, about 5% of cases these calcifications are incidentally found on panoramic radiographs. Although numerous opaque lesions with indistinct boundaries are detected in radiographs, especially when they are over palatal uvula, ramus, tonsilloliths are obligatory to be regarded as the primary differential diagnosis [9]. Tonsilloliths were prevalent in this study at 1.4%. Even though this prevalence is not that high, the tonsilloliths can be an indicator of chronic inflammation, it is important to note that they can be identified on radiographs and diagnosed and managed accordingly.

The soft tissue calcifications in the current study were found in most people between the ages of 30 to 60 years (67.8%). The findings are in agreement with those of Darwin D et al. who also stated higher prevalence of calcifications in individuals older than 40 years. Calcinosis usually begins at a relatively young age without apparent symptoms or radiographic appearances. This process is progressive and over time the calcium deposits accumulate in the soft tissues. The development of calcinosis in older individuals results in greater and more pronounced deposits such that they become more prominent on radiographs. [10]

5. Conclusion

The analysis is based on the occurrence and patterns of the soft tissue calcification in head and neck area having emphasis on their diagnostic importance in panoramic radiography. The most common finding was the existence of stylohyoid ligament calcification as reported before, then the tonsilloliths and parotid gland calcification. Such calcifications are usually asymptomatic, although they may represent the presence of systemic disease or localised pathological changes, e.g. venous malformations or abnormalities of the salivary glands. The paper highlights the importance of identifying such calcifications during regular radiography checkups to help in the early identification or treatment of associated risks such as cardiovascular problems. The findings support utilization of panoramic radiography as good diagnostic tool for detecting soft tissue calcifications.

Declarations:

Conflict of Interest: Authors declare that there is no conflict of interest related to this study.

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Ethics Approval: Institutional scientific review board approval was obtained, as the study involved anonymized digital orthopantomograph (OPG) images with no direct patient involvement.

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