



Prevalence of Soft Tissue Calcifications in Panoramic Radiographs of Patients Referred to Guilan School of Dentistry Within 1 Year and its Relationship With Systemic Diseases

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Abstract

Background: Soft tissue calcifications are the deposition of calcium salts, mainly calcium phosphate, in soft tissue. They most often are detected as incidental findings during radiographic examinations. The goal is to identify them correctly to determine whether treatment is required. The aim of this study was to investigate the prevalence of soft tissue calcifications in panoramic radiographs and their relationship with age, gender and underlying diseases.

Methods: In this descriptive cross-sectional study, panoramic radiographs of 654 patients were examined within one year. The prevalence of soft tissue calcification, their location and certain factors such as age, sex, underlying disease were examined.

Results: The prevalence of elongated stylohyoid ligament calcification, laryngeal cartilage calcification, carotid artery calcification, lymph node calcification, and sialolith were 20.2%, 9.8%, 2.4%, 1.8%, 0.6%, and 0.1%, respectively. Stylohyoid ligament and vascular calcifications were significantly correlated with cardiovascular disease and hypertension. Gender and soft tissue calcification were not significantly associated. The prevalence of tonsillolith was significantly higher in men ($P=0.0001$). A significant correlation was found between soft tissue calcification and age groups, so that as age increased, the prevalence of carotid artery calcification, stylohyoid ligament calcification, and tonsillolith increased.

Conclusions: The present study shows that soft tissue calcifications are not unusual findings in panoramic radiographs. They increase significantly with aging but have no significant association with gender. The prevalence of soft tissue calcification is higher in cardiovascular disease patients.

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Background

Calcifications in the head and neck region may be accidentally detected in panoramic radiographs and they may have no signs or symptoms. Some calcifications may not need further intervention in long-term follow-up sessions but some of them may need medication and treatments because they may be life-threatening. Deposition of calcium salts, especially calcium phosphate, mostly occurs in skeletal system. If it occurs in a disorganized form in soft tissues, it is called heterotopic calcification and if it occurs in an organized form in soft tissues, it is called heterotopic ossification. Calcifications occur in lymph nodes, tonsils, and blood vessels. Sialolithiasis, phleboliths, rhinoliths, antroliths and laryngeal cartilage calcification are the most common types of heterotopic calcifications in the

Highlights

- Soft tissue calcification considerably increases with aging and prevalence of soft tissue calcification is higher in cardiovascular patients.

head and neck region. Stylohyoid ligament calcification, osteoma cutis, and myositis ossificans are classified as heterotopic ossifications (1,2). Soft tissue opacities are relatively common and are observed in 4% of panoramic radiographs (3). The incidence rate of such calcifications is higher in adults aged over 40 years but they have also been reported in young children as well (4).

Calcified deposits in radiographs may vary in size from 1 mm to a few centimeters and can be single or multiple. The most important diagnostic criteria of the

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soft tissue calcifications include their anatomic location, number, distribution, size, and shapes. The study of exact anatomic location requires adequate information about the position of lymph nodes, stylohyoid ligaments, blood vessels, larynx cartilage and main salivary gland duct (5). It may, however, be difficult to detect the exact position of calcifications due to formation of double real and ghost images. Hyoid bone, styloid process, superior horn of thyroid cartilage, and epiglottis should be considered as differential diagnosis (4).

Generally, the clinical priority of soft tissue calcifications is their appropriate diagnosis in radiographs (1). Thus, dentists must have adequate knowledge on anatomic and pathologic opacities, the principles of picture formation in panoramic radiographs as well as the ability to make differential diagnosis. Dentists must also assess the necessity of further intervention on the basis of differential diagnosis and make the patient aware of the further risks and pathological conditions.

Thus, current study was conducted to investigate the prevalence of soft tissue calcifications in panoramic radiographs of patients referring to the Dentistry School of Guilan University of Medical Sciences and to assess the potential relationship of these calcifications with age, gender, and systemic diseases of the cardiovascular system and the kidney.

Materials and Methods

Panoramic radiographs of 654 individuals (320 males, 334 females) selected by cluster sampling were examined for the presence of soft tissue calcifications. Using the names of the patients, their hospital case numbers were drawn to access their detailed information. In case of missing information, low quality radiograph, or technical failure, another individual was included in the study. Data such as age, gender, systemic disease and absence or presence of calcifications (calcifications of lymph node, blood vessels, larynx cartilage, and stylohyoid ligament, osteoma cutis, myositis ossificans, tonsillolith, sialolithias, phlebolith, rhinolith, and antrolith) was drawn from the patients' hospital cases. All radiographs were captured using a Cranex D (Scordex, Finland) in the Oral and Maxillofacial Department of Guilan University of Medical Sciences and evaluated by an oral and maxillofacial radiologist to detect potential soft tissue calcifications.

To determine the calcification of stylohyoid ligament, radiographs were entered into Scanora software to assess the length of stylohyoid process from the radiolucent border between the base of the styloid process and temporal bone, to the tip of ossified ligament. Calcification and distances over 30 mm were considered as elongated (calcified) process. Then, the data was entered into the SPSS version 21. Chi-square test was used to compare different types of soft tissue calcifications in different groups, and Fisher exact test was used to investigate the relationship between systemic diseases and soft tissue

calcifications ($\alpha=0.05$).

Results

Based on our results, out of the 654 evaluated radiographs, 201 (30.7%) exhibited soft tissue calcifications. Among individuals with soft tissue calcifications, 175 (26.8%) had 1 type of calcification, 24 (3.7%) had 2 types of calcifications, and 2 (0.3%) had 3 types of calcifications (collectively, 229). The highest prevalence of calcification was obtained for stylohyoid ligament calcification (20.2%), followed by tonsillolith (9.8%), laryngeal cartilage calcification (2.4%), vascular calcification (1.8%) lymph node calcification (0.6%) and sialolith (0.1%). Antrolith, rhinolith and phlebolith were not detected in our radiographs (Figure 1).

Out of 201 individuals exhibiting soft tissue calcification, 102 were male (15.6%) and 99 (15.1%) were female. The Chi-squared test results showed no significant difference in the presence of calcifications between men and women ($P=0.438$), but regarding the prevalence of different types of calcifications in the two genders, a significant relationship was observed between gender and tonsillitis ($P=0.0001$) so that the prevalence of this type of soft tissue calcification was 76.6% in men that was higher than that in women. Although the prevalence of other types of calcifications were higher in women than in men, the difference was not statistically significant (Table 1).

The age range of our participants was 4-38 (average: $34.74 + 17.41$) years. The Chi-squared test results showed a significant and direct correlation between age groups and presence of calcification ($P < 0.0001$).

According to the chi-square test results, a significant relationship was observed between age groups and stylohyoid ligament calcification (40-50 years), vascular calcification (over 50 years), and tonsillolith (50-60 years) with the prediction value of 0.0001, 0.0001, and 0.001, respectively (Table 2).

Regarding the frequency of bilateral or unilateral calcifications, 78% of stylohyoid ligament calcifications, 59.3% of tonsillolith, 93.7 % laryngeal cartilage calcifications, and 50% of lymph node and vascular

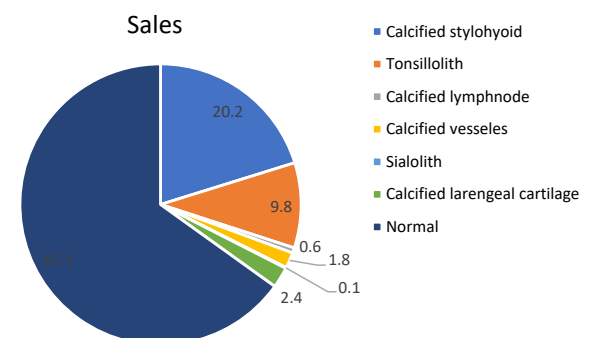


Figure 1. Prevalence of Soft Tissue Calcification in Studied Samples

Table 1. Evaluation of Relation Between Gender and Different Types of Soft Tissue Calcifications

Calcification	Gender		Total	P Value
	Male	Female		
Stylohyoid	74(56%)	58(44%)	132(100%)	0.244
Tonsillolith	15(23.4%)	49(76.6%)	64(100%)	0.0001
Laryngeal cartilage	11(68.7%)	5(31.3%)	16(100%)	0.163
Vessels	7(58.3%)	5(41.7%)	12(100%)	0.634
Lymph nodes	2(50%)	2(50%)	4(100%)	0.951
Sialolith	0(0%)	1(100%)	1(100%)	---

calcifications were bilateral and 1 case of sialolithiasis was found to be unilateral.

In the present study, 117 individuals had at least one systemic disease. The chi-squared test results showed that soft tissue calcification was significantly associated with heart disease and hypertension ($P=0.0001$), so that over 60% of participants suffering from the two diseases had soft tissue calcifications (Table 3).

The relationship between systemic disease and calcifications was also assessed using chi-square test and a significant relationship was found between the following: stylohyoid ligament calcification and history of hypertension and heart and kidney diseases; tonsillolith and diabetes and hyperlipidemia; calcification of larynx cartilage and blood vessels and heart and thyroid diseases; and lymph node calcification and hyperlipidemia (Table 4).

Discussion

In the 654 radiographs studied, the highest prevalence of soft tissue calcifications was obtained for stylohyoid ligament calcification (30.7%), followed by tonsillolith,

which is consistent with the results of other studies (6,7). However, in a similar study in Brazil, 3028 panoramic radiographs were studied with the aim of assessing the incidence of soft tissue calcifications in the mandibular angle area, and the highest incidence was obtained for tonsillolith (5); however, stylohyoid ligament calcification was excluded from that study so the mentioned results seem to have been achieved due to this point. Vengalath et al reported that out of different types of calcifications, the most prevalent type, unlike most studies, was carotid artery calcification in postmenopausal women in India (8).

Differences in the studied communities or assessment methods can contribute to the varied prevalence of soft tissue calcifications in various studies. Additionally, small calcifications cannot be generally detected in radiographs, and therefore the incidence of soft tissue calcifications is expected to be higher than the reported results. Only in one study, cone beam computed tomography was used to assess the prevalence of soft tissue calcifications but stylohyoid ligament calcification was excluded from that study (9).

Table 2. Evaluation of Relation Between Age and Different Types of Soft Tissue Calcifications

Calcification	Age						P Value
	<20	20<age<30	30<age<40	40<age<50	50<age<60	>60	
Stylohyoid	2 (1.5%)	21 (15.9%)	33 (25%)	34 (25.8%)	33 (25%)	9 (6.8%)	0.0001
Tonsillolith	1 (1.6%)	10 (15.6%)	12 (18.8%)	14 (21.9%)	17 (26.6%)	10 (15.6%)	0.0001
Laryngeal cartilage	0 (0%)	1 (6.2%)	3 (18.8%)	6 (37.5%)	3 (18.8%)	3 (18.8%)	0.071
Vessels	0 (0%)	0 (0%)	1 (8.3%)	3 (25%)	4 (33.3%)	4 (33.3%)	0.001
Lymph nodes	0 (0%)	1 (25%)	1 (25%)	2 (50%)	0 (0%)	0 (0%)	0.522
Sialolith	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	----

Table 3. Evaluation of Relation Between any Systemic Diseases in Individuals and Soft Tissue Calcifications

Disease	Calcification		Total	P value
	+(%)	-(-%)		
Hypertension	31 (63.3)	18 (36.7)	49 (35.8)	0.0001
Diabetes mellitus	11 (44)	14 (66)	25 (18.2)	0.143
History of heart disease	14 (77.8)	4 (22.2)	18 (13.1)	0.0001
Kidney disease	7 (50)	7 (50)	14 (10.2)	0.114
Thyroid disease	6 (40)	9 (60)	15 (11)	0.431
Cerebrovascular disease	----	1 (100)	1 (0.7)	----
hyperlipidemia	7 (46.7)	8 (53.3)	15 (11)	0.176

Table 4. Evaluation of Relation Between any Systemic Diseases in Individuals and Different Types of Soft Tissue Calcifications

	Systemic Disease	Samples	Total Calcified Samples	Calcification	Calcification (%)	P Value
Calcified stylohyoid ligament	Hypertension	49	37	25	67.6	0.0001
	Diabetes mellitus	25	15	7	46.6	0.321
	History of heart disease	18	15	8	50	0.009
	Kidney disease	14	9	6	66.6	0.033
	Thyroid disease	15	8	3	37.5	0.986
	Hyperlipidemia	15	11	6	54.5	0.053
Tonsillolith	Hypertension	49	37	7	18.9	0.511
	Diabetes mellitus	25	15	6	40	0.015
	History of heart disease	18	15	3	18.7	0.319
	Kidney disease	14	9	3	33.4	0.138
	Thyroid disease	15	8	1	12.5	0.681
	Hyperlipidemia	15	11	4	36.4	0.026
Calcified laryngeal cartilage	Hypertension	49	37	2	5.4	0.642
	Diabetes mellitus	25	15	2	13.3	0.149
	History of heart disease	18	15	2	12.5	0.040
	Kidney disease	14	9	0	0	0.836
	Thyroid disease	15	8	2	25	0.015
	Hyperlipidemia	15	11	0	0	0.825
Calcified vessels	Hypertension	49	37	2	5.4	0.211
	Diabetes mellitus	25	15	0	0	0.486
	History of heart disease	18	15	2	18.8	0.0001
	Kidney disease	14	9	0	0	0.605
	Thyroid disease	15	8	2	25	0.001
	Hyperlipidemia	15	11	0	0	0.592
Calcified lymph nodes	Hypertension	49	37	1	2.7	0.174
	Diabetes mellitus	25	15	0	0	0.689
	History of heart disease	18	15	0	0	0.736
	Kidney disease	14	9	0	0	0.767
	Thyroid disease	15	8	0	0	0.759
	Hyperlipidemia	15	11	1	9	0.002

The prevalence of soft tissue calcifications in our study was not found to be significantly related to gender, which confirms the results of other studies (6,7,9). In the studies of Garay et al and Vengalath et al, however, this association was significant so that soft tissue calcifications were more prevalent in men than in women (5,8). This may be related to the random distribution of men and women in those studies.

The findings of the present study showed a direct and significant correlation between soft tissue calcification and age, which is in consistency with the results of other studies (5,8). However such relationship was not found in the study of Nunes. This may be due to the fact that the majority of patients with calcification are 35-55 years (7).

Similar to other studies, the threshold for elongated stylohyoid ligament complex was set to be 30 mm in this study and the prevalence of this calcification was found to be 20.2%.

In one study conducted by Raviraj et al, 430 panoramic radiographs of stoichiometric calcification reported to be 17.3% of a population of city of Turapati, India. In Brazil, Vieira et al (11) studied 736 panoramic radiographs in

a central population of Brazil showed the result to be 43.89%. And finally, Ilgüy et al (12), in a survey of 860 panoramic radiographs reported it at 3.7% .

Based on our results, the incidence rate of bilateral stylohyoid ligament calcification was 78% and was higher than that of unilateral type of this calcification (22%). This is consistent with the findings of Ghaffari et al and Ilgüy et al (12,13).

Our study showed that, with aging, the prevalence of stylohyoid ligament calcification increased significantly, with the highest incidence rate in the fifth decade of life. And although the incidence rate of this type of calcification was higher in women than in men, the association between sex and calcification was not statistically significant. This is consistent with the studies of Ghaffari et al (13), Raviraj et al (10), and Vieira et al (11). In addition, stylohyoid ligament calcification showed no relationship with kidney diseases, high blood pressure, and history of heart disease.

A significant relationship was observed between soft tissue calcification and a history of heart disease and hypertension.

In the current study, the prevalence of tonsillolith was

9.8% that is approximate to the results of the previous studies (6,14). Ghabanchi et al reported the incidence rate of this type of calcification to be 5.05% in 2000 panoramic radiographs in a population from southern Iran (15). Takahashi et al reported the incidence of tonsillolith to be 13.4% and 40.7% in the panoramic radiographs and CT scans, respectively. That study was performed in Tokushima, Japan with 2244 samples (16). In a study conducted by Fauroux et al, the prevalence of tonsillolith was reported 24.6% in 150 CT scans (17). Comparatively higher incidence in the last cited two studies can be due to the higher diagnostic efficacy of CT scanning compared to panoramic radiography. In the study of Imani Moghaddam et al, the prevalence of tonsillolith was reported 39.66%, of which 43% had recurrent throat infection, and 4% had tonsillectomy. This inconsistency could be attributed to higher number of patients with clinical symptoms in the studied population (7).

The incidence rate of unilateral tonsillolith was found to be higher than that of bilateral type in the study of Ghabanchi et al and Fauroux et al (15,17). Although they reported a higher incidence rate for unilateral tonsillolith, this finding can be due to differences in studied samples and populations.

In the present study, there was a significant relationship between tonsillolith and age, so that the prevalence of tonsillolith increased with aging and the highest incidence of this type of calcification was observed in individuals aged 50-60 years. Tonsillolith was also more frequent in men, which is consistent with some studies (5,15). This contradicts with the study of Fauroux et al, in which age and sex were not significantly related with tonsillolith (17).

In the present study, the prevalence of laryngeal cartilage calcification was 2.4% and most of them were bilateral (7).

Age and sex have been reported to be significantly associated laryngeal cartilage calcification in recent studies (18,19), which is inconsistent with the results of the present study. Clearly, there are inconsistencies in the results of previous studies. Moreover, in the current study laryngeal cartilage calcification was found to be related to history of heart and thyroid diseases.

The prevalence of vascular calcifications was 0.8% in the current study. Ezoddini-Ardakani et al reported this prevalence to be 2%, which is close to the prevalence obtained in the current study (6). Based on Kumagai et al findings in Japan, 2374 panoramic radiographs showed a 4% occurrence in them (20). Other studies (21,22) reported different incidence rates of calcifications. This may be attributed to differences in age, sex, race, and lifestyle.

In this study, the number of unilateral and bilateral vascular calcifications was equal while previous studies (21-24) reported a higher rate for either of the types. According to the study of Garay, age and vascular calcification were associated and the highest incidence

rate was observed in people aged over 50 years (5). Moreover, the relationship between vascular calcification and heart disease confirms the results of Taheri and Moshfeghi (22). According to the studies of Taheri & Moshfeghi and Kumagai et al, vascular calcification is significantly associated with blood pressure and lipids (20,22). Vascular calcification and kidney disease showed no association in this study, which is consistent with the results of Patil et al (4). On the contrary, Gokce et al reported a high incidence of carotid artery calcification in the end-stage renal disease patients (25).

In previous studies, vascular calcifications were reported as an important factor for increased risk of stroke and history of cerebrovascular disease (20,26). In our study, like the study of Ezoddini-Ardakani et al (6), such relationship was not found. The small number of patients with history of cerebrovascular disease is one of the reasons for this finding.

In this study, the prevalence of lymph node calcification was lower than that reported by others (6,7). This may be due to the relatively higher number of people with history of tuberculosis and BCG vaccination in the studied population. However, age and gender were not significantly associated with the prevalence of lymph node calcification, which is consistent with the findings of previous studies (6,7). It should also be mentioned that the relationship between lymph node calcification and hyperlipidemia was statistically significant.

Conclusions

Present study showed that soft tissue calcification is a relatively common finding in panoramic radiographs. Generally, the prevalence of these calcifications increased with aging, but their incidence in men and women were not significantly different. Moreover, they were detected more frequently in people with a history of cardiovascular disease. Therefore, due to their potential relationship with certain systemic diseases, it seems necessary for the dentists to refer these patients to specialists when certain types of calcifications are detected in them. Moreover, given the relatively inconsistent results regarding the relationship between soft tissue calcifications and some systemic diseases including those of the kidney and cardiovascular system, it is suggested that more carefully designed studies be conducted only on patients suffering from systemic diseases.

Authors' Contribution

AJ: study conduct, management. AN: manuscript preparation, article edition, study implantation. SS: Data analysis, article preparation.

Ethical Statement

This study was approved by the Ethics Committee of Guilan University of Medical Sciences (No. IR.GUMS.REC.1394.464).

Conflict of Interest Disclosures

The authors declare that they have no conflict of interests.

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