Heterotopic Calcifications in Panoramic Radiography: A Case Study of Patients Referred to Kashan Radiology Centers in 2020 to 2021

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Abstract

Introduction: Heterotopic calcifications are usually observed as random findings in panoramic imaging, and in some cases, they can indicate an underlying disease in patients. This study was carried out with the aim of determining the prevalence of heterotopic calcifications in panoramic radiographs of patients referred to radiology clinics in Kashan in 2020–2021.

Method: This research was a cross-sectional descriptive study in which radiographic images of 990 patients were examined. The investigated features, including the type, location, number of lesions in each person and whether they are unilateral or bilateral, prevalence and type of heterotopic calcification, and their location, were recorded and analyzed.

Findings: In this study, 990 radiographic images were examined, of which 320 cases (32.32%) had calcification, and these lesions were not related to the age and gender of the patients. The most common sites of heterotopic calcification in people referred for panoramic imaging were the ligament (83.8%) and tonsillitis (9.1%), respectively. In this study, 70% of the participants had bilateral heterotopic calcification, and in 92.5% of cases, they had only one calcification. In examining the location of calcification only in tonsillitis lesions, the male population was significantly higher than the female population ($p = 0.008$). In the location of other lesions, there was no difference between male and female populations ($p > 0.05$). In examining the side of the lesions and the number of calcification cases, there was no significant difference between male and female populations ($p > 0.05$).

Conclusion: In this study, ossification of the stylohyoid ligament and calcification of the tonsils were the most prevalent among soft tissue calcifications in the head and neck region. In this study, the prevalence of soft tissue calcifications in the head and neck area was not related to the age and gender of the patients, except for the cases of calcification in the tonsils area, which were related to male gender. Most of the lesions were bilateral, often one.

Keywords: soft tissue calcification, panoramic imaging

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INTRODUCTION

Radiography is an essential requirement in the diagnosis of dental diseases and plays a significant role in completing the diagnosis (1, 2). Calcium salts, mainly calcium phosphate, are usually present in the skeleton, and when their deposition process occurs in soft tissue in a disorganized manner, it is referred to as "heterotopic calcification" (3). Heterotopic calcifications, which are common in the soft tissue in the jaw and face area, are generally detected in radiographs of routine examinations such as panoramic radiographs, especially in the maxillofacial area. The most important diagnostic criteria are the anatomical location, distribution, number, size, and shape of calcifications (4). These calcifications may be present in vessels, ligaments, glandular tissues, or associated with inflammation and chronic wounds (5). Differential diagnosis should be done with the hyoid bone, pterygoid cartilage, styloid appendage, superior horn of thyroid cartilage, and epiglottis. Epidemiologically, these calcifications are more common in people over 40 years of age; however, a few cases in children have been reported (6).

Sialolithiasis is the second-most common disease in the major salivary glands after parotiditis, with a higher prevalence in men between 30 and 60 years of age (13). Also, phleboliths are thrombotic idiopathic calcifications that are often associated with vascular lesions in the head and neck (14).

In this study, it was suggested that, due to the prescription of panoramic radiography by most dentists, it is important to pay attention to soft tissue calcifications and heterotopic calcifications. Also, by observing these calcifications, the dentists refer the patients to the relevant specialist colleagues for further examinations (15).

Panoramic radiography is a method of choice in most dental treatments, including orthodontics, prosthetics, surgery, etc., due to its low radiation dose and low cost (16). Considering the wide range of pathologies and disorders that are caused by these lesions in people, investigating the prevalence of each type of calcification can help in the better diagnosis of lesions. Panoramic radiography is the imaging of choice for simultaneous evaluation of both jaws in most dental treatments and screening studies. Therefore, due to its popularity, it is essential to familiarize dental practitioners with the patterns and characteristics of soft tissue calcification on panoramic

radiographs. Also, because these calcifications are often asymptomatic and discovered incidentally on imaging, their initial evaluation with 3D imaging is not justified unless the patient is symptomatic. If the calcifications are asymptomatic, the patient is exposed to unnecessary radiation by preparing 3D images. Considering the potential of calcification in soft tissue to create the appearance of pathological lesions and gather sufficient information about their characteristics in panoramic radiographs, this study aimed to determine the prevalence of heterotopic calcifications in panoramic radiographs of patients referred to Kashan radiology clinics. It should be noted that so far this study has not been conducted in Kashan city, and considering that the results of this study were different in each geographical and genetic region in that area and there was not enough information in Kashan city, it was necessary to conduct this study.

Method

The present study was a cross-sectional descriptive study that was conducted on the radiographic data of 990 patients referred for digital panoramic imaging at the radiology center of Kashan from 2020 to 2021. The inclusion criteria included being older than 12 years, and the exclusion criteria included images with radiological errors and defects in the available information about the patient. After receiving the code of ethics from the university, samples were collected. During the study, the names of the patients and their personal information were not revealed. The radiographic images were approved by a special radiology technician, and then the images were verified by two experienced maxillofacial radiologists. Later, the same experts performed the evaluations to determine the variables of the study. The radiographs were reviewed for the presence of any calcifications by a radiologist as well as by an expert (a final-year student). The characteristics, including the type, location, number of unilateral or bilateral cases, and side of the lesion, were recorded in the data collection form that was prepared in advance. The prevalence and type of heterotopic calcification, their location, and their relationship with age, sex, and risk factors were evaluated. Also, in cases of calcification prevalence, calcified styloid ligament, enterolith, phlebitis, calcified atherosclerotic plaque, tonsil, sialuliths, calcified lymph nodes, tonsillitis, osteoma cutis, and calcification of laryngeal cartilage were also recorded. To describe the demographic data of patients, mean and standard deviation were used for quantitative data, and frequency and frequency percentage were used for qualitative data. The demographic information of the patients was compared using the chi-square test, and data analysis was done with Fisher's exact test. The study data was analyzed using SPSS software version 26, with a significance level of 0.05.

Findings

In this study, which was conducted with the aim of determining the prevalence of heterotopic calcification in digital panoramic radiology images of patients who visited the radiology center of Kashan from 2020 to 2021, 990 digital panoramic radiology images were examined, of which 320 images had heterotopic calcification.

Table 1. Demographic and background characteristics of patients with calcification in panoramic images

Variable		Frequency/Mean	Frequency Percentage/ Standard Deviation
Age	less than 29 years	98	30.6
	30 to 39 years	101	31.6
	Above 40 years	121	37.8
Average age of patients		36.92	12.247
Gender	Male	156	48.8
	Female	164	51.2
Location of the lesion	phlebolith	4	1.3
	Tonsillolith	29	9.1
	at the thyroid site	14	4.4
	At the carotid site	10	3.1
	in place of lymphatic vessels	20	6.3
	in place of the ligament	268	83.8
	Unilateral	44	13.8

Side of the lesion	Bilateral	224	70
Number of the lesion	One	296	92.5
	Two	21	6.6
	Three	3	0.9
Total		320	100%

Table 1 shows the demographic and background characteristics of patients with calcification in panoramic images. As can be seen in the above table, the average age of the patients is 36.92 ± 12.25 years (from 12 to 78 years), and the most common age group in which calcification is seen are patients over 40 years old. The most common location of heterotopic calcification in people referred for panoramic imaging is in the ligament (83.8%) or tonsillitis (9.1%), respectively. In this study, 70% of the participants had bilateral heterotopic calcification, and in 92.5% of cases, they had only one calcification.

Table 2 shows the location, direction, and number of calcifications according to the gender of the patients. As shown in Table 2-4, in examining the location of calcification only in tonsillitis lesions, the male population was significantly higher than the female population ($p = 0.008$). In the location of other lesions, there was no difference between male and female populations ($p > 0.05$). In examining the side of the lesions and the number of calcification cases, there was no significant difference between the population of men and women ($p > 0.05$).

Table 2. The location of the lesion according to gender

Variable			Gender		*P value
			Male	Female	
Location of the lesion	phlebolith	Frequency	3	1	0.291
		Frequency Percentage	75.00%	25.00%	
	Sialolith	Frequency	1	1	0.972
		Frequency Percentage	50.00%	50.00%	

	Tonsillolith	Frequency	21	8	0.008
		Frequency Percentage	72.40%	27.60%	
	at the thyroid site	Frequency	6	8	0.652
		Frequency Percentage	42.90%	57.10%	
	At the carotid site	Frequency	5	5	0.936
		Frequency Percentage	50.00%	50.00%	
	in place of lymphatic vessels	Frequency	12	8	0.299
		Frequency Percentage	60.00%	40.00%	
	in place of the ligament	Frequency	126	142	0.159
		Frequency Percentage	47.00%	53.00%	
Side of the lesion	Unilateral	Frequency	25	19	0.154
		Frequency Percentage	56.8%	43.2%	
	Bilateral	Frequency	101	123	
		Frequency Percentage	45.1%	54.9%	
The number of lesions	One	Frequency	140	156	0.189
		Frequency Percentage	47.3%	52.7%	
	Two	Frequency	14	7	

		Frequency	66.7%	33.3%	
		Percentage			
	Three	Frequency	2	1	
		Frequency	66.7%	33.3%	
		Percentage			
Total		Frequency	156	164	320
		Frequency	48.8%	51.2%	100%
		Percentage			

*chi square

Table 3 shows the findings of the study in relation to the location, direction, and number of calcification cases according to their age. According to the above table, it can be seen that there was no difference between different age groups in examining the location of lesions, the direction, and the number of calcification cases in people. In fact, there was no significant relationship between these factors and the age of the patients ($p > 0.05$).

Table 4-3. Calcification according to the age of patients

Variable			Age Groups			p value*
			Less than 29 years	30-39	More than 40 years	
location of the lesion	phlebolith	Frequency	2	1	1	0.695
		Frequency Percentage	50.00%	25.00%	25.00%	
	Sialolith	Frequency	0	0	2	0.191
		Frequency Percentage	0.00%	0.00%	100.00%	
	Tonsillolith	Frequency	7	9	13	0.652

		Frequency	24.10%	31.00%	44.80%	
		Percentage				
	at the thyroid site	Frequency	1	7	6	0.116
		Frequency Percentage	7.10%	50.00%	42.90%	
	At the carotid site	Frequency	3	1	6	0.239
		Frequency Percentage	30.00%	10.00%	60.00%	
	in place of lymphatic vessels	Frequency	4	9	7	0.352
		Frequency Percentage	20.00%	45.00%	35.00%	
	in place of the ligament	Frequency	85	83	100	0.627
		Frequency Percentage	31.70%	31.00%	37.30%	
side of the lesion	Unilateral	Frequency	19	10	15	0.175
		Frequency Percentage	43.20%	22.70%	34.10%	
	Bilateral	Frequency	66	73	85	
		Frequency Percentage	29.50%	32.60%	37.90%	
The number of lesions	One	Frequency	94	93	109	0.189
		Frequency Percentage	31.80%	31.40%	36.80%	
	Two	Frequency	4	7	10	
		Frequency Percentage	19.00%	33.30%	47.60%	

	Three	Frequency	0	1	2	
		Frequency Percentage	0.00%	33.30%	66.70%	
Total		Frequency	98	101	121	320
		Frequency Percentage	30.6	31.6	37.8	100%

*chi square

Discussion

Since soft tissue calcifications can be affected by the lifestyle or even the ethnic and racial differences of people, and considering the numerous studies that have been done in other countries about soft tissue radiopacities and their importance and the small number of similar studies in Iran, the present cross-sectional study investigated the prevalence of soft tissue calcification in patients referred to the dental clinic of Kashan University of Medical Sciences during the years 2020–2021. In this study, panoramic radiographs were used to detect these calcifications.

In this study, the prevalence of calcification was not related to age group. Similar to the findings obtained, according to the results of different studies obtained from different similar studies, Javadzadeh (48) and Vengalath (41), the average age of the studied population cannot be considered a suitable predictive factor for the prevalence of soft tissue calcification. However, in the study of Riberio et al. (44), they found that calcification of the stylohyoid ligament, carotid artery, and tonsillolith increases in people over 51 years old.

In this study, the overall prevalence of soft tissue calcification was 32.32% in 990 panoramic radiographs. Based on the results, there was no correlation between the overall prevalence of calcification and the age and gender of the patients. In the study of Ezzedini et al., the prevalence of soft tissue calcification was stated as 39.2%. Also, Icoz et al. (45), in a study, reported the prevalence of calcification in soft tissue to be 6.4. Also, Imani Moghadam et al. (25) reported this rate as 6.4%. In the study by Imani Moghadam et al., although soft tissue calcification was more common in women than in men, no significant difference in the prevalence between the two genders was observed (25).

The low rate of prevalence in these studies can be seen as the reason for not considering stylohyoid ossification or not investigating some of its cases (55). Like Ferrario et al. (55), we are also of the opinion that due to the way of sample selection and the difference of radiographic indicators to detect calcification, the results of such descriptive studies can be different and not directly comparable. Also, Mansour (56) stated in his study that the superimposition of mandibular

opacities can imitate soft tissue calcification and lead to the radiologist's error in distinguishing the two from each other and has an impact on the reported prevalence.

The most common site of aberrant calcification in people referred for panoramic imaging was in the place of the ligament and then the tonsils. Based on the results obtained in this study, the rate of calcification in the stylohyoid ligament area among all cases of calcification was 83.8%. However, its overall prevalence among all examined images was 27%. In a similar study conducted by Wantabe et al. (57), the rate of calcification in the region of the stylohyoid ligament was reported to be 18%. Okabe et al. (53) who investigated the calcification of the stylohyoid area in people older than 85 years declared its prevalence to be 21.2%. Similar to the obtained result, Ezzedini et al. (51) in Yazd also obtained a similar result to the present study and reported that the highest frequency of soft tissue calcifications was stylohyoid ossification (54%). Ribeiro et al. also reached a similar result and stated that the ratio of ossification of the stylohyoid ligament to the total calcifications was 66% (58). Omami also considered this type of calcification to be a common finding in panoramic radiographs. In the study of Imani Moghadam et al. (25), the prevalence of stylohyoid calcification among all cases of calcification was declared to be 80%, which was more common among all the Radiopacities examined by them. Scarfe stated that, depending on the sample population, approximately 1.2–35% of individuals had evidence of stylohyoid calcification on panoramic radiographs. The difference in panoramic devices and the difference in the radiation angle of the device can be considered as the reasons for the different results. Also, these differences can be due to differences in samples and target populations. Scaf et al. (59) believed that the results of descriptive prevalence studies were not comparable with each other because of the differences in the target statistical communities in terms of age, race, number, and also differences in radiographic criteria.

In the study conducted, no significant relationship was observed between the location of calcifications and the age of the patients. However, contrary to the findings, Imani Moghadam et al. (25) showed a significant relationship between stylohyoid ligament calcification and aging. Wantabe et al. (57) also concluded that the prevalence of calcification increases with age, and in their study, the highest prevalence of calcified stylohyoid ligament was observed between 50 and 63 years of age.

In examining the location of calcification only in tonsillitis lesions, the population of men was significantly higher than that of women. In the location of other lesions, there was no difference between the population of women and men. So, in this study, stylohyoid calcification was not related to the age and gender of the patients. Similarly, Shakibaei et al. (54) reported in a study a high prevalence of stylohyoid ossification in the age group of 20 to 40 years without any relationship with gender. In Imani Moghadam's study (25), a significant difference was observed between age and stylohyoid complex calcification. Other studies also confirmed the relationship between age and appendage length (60). In Imani Moghadam's study, stylohyoid complex calcification was observed more frequently in women than in men, but the difference was not

significant. Ilguy reported that the calcification rate of the stylohyoid ligament is higher in women (61).

In the present study, the highest frequency of calcifications after ossification of the stylohyoid was related to tonsils at a rate of 9.1% of all cases of calcifications and 2.9% of all investigated cases. This finding was almost consistent with the study of Ezzedini et al. (51) and the results of Imani Moghadam et al. (25) in Iran.

In these studies, the prevalence of this calcification among other calcifications was reported as 25.86 and 16.5, respectively. In the study of the prevalence of this calcification in southern Austria, Sutter (43) reported it at 3.6%, which included 19% of all calcifications and is consistent with the present study. Riberio et al. (44) also declared the prevalence of this calcification to be 0.9%, which included 9.5% of all calcifications in this study. In the conducted study, calcification of lymphatic vessels was evaluated in 6.3% of all calcification cases and 2.2% of all examined images. This amount was not related to the age and gender of the patients. In the study of Safabakhsh et al. (47) in 2017, calcification of lymph nodes was found in 9 cases (0.2%). In another study by Haqiqat (46) in 2018, the calcification of lymph nodes was 0.6%. In a study conducted by Icoz (45) in 2019 with the aim of determining the frequency of soft tissue calcification in panoramic radiographs, he detected the prevalence of calcified lymph nodes at 0.6%. According to the results obtained from the present study, the prevalence of carotid artery calcification was reported as 3.1% of all calcification cases. Meanwhile, Vengalath considers this amount to be 2 to 11%, which is not much different from the present study. According to Herniques et al. (64), the process of vascular calcification starts at a young age and manifests itself after 45 years. In the study of Imani Moghadam (25) et al., the prevalence of calcification in the lymphatic vessels was 20.86%. One of the causes of calcification in this area is said to be the general BCG vaccination since 1943, and in White's book, one of the etiological causes is BCG vaccination (25).

In the current study, the relationship between carotid artery calcification and age was not significant. Vengalath and Monteiro showed that carotid artery calcification is more common in women. According to the study of Karwowski et al. (65), the cause of this calcification in women can be attributed to hormonal disorders after menopause. This is despite the fact that in the present study, no significant difference was seen according to the gender of the patients. This difference in the results can be attributed to the low sample size in the present study and the lower prevalence of carotid artery calcification compared to other studies.

In the present study, the lowest frequency observed was related to sialolith and phlebolith, respectively. In the articles of Imani Moghadam (25) and Ezzedini, the frequency of sialolith was low compared to other soft tissue calcifications. Omami is of the opinion that panoramic radiography is not accurate enough to detect salivary gland stones, and only if the amount of calcification and its size are large enough can they be detected in this type of radiography. This explains the small difference in the prevalence of sialolith in the aforementioned similar studies.

In the present study, no cases of rhinolith or enterolith calcification were observed. These calcifications are an uncommon finding. In the study by Ribeiro et al., which was conducted in Portugal, only 1 case of enterolith and 1 case of rhinolith were found in 2375 examined graphs, which indicates the rarity of these calcified lesions. Some, like Khojastepour (66) and Ezzedini, reached a similar conclusion.

In this study, 70% of the participants had bilateral heterotopic calcification, and in 92.5% of cases, they had only one calcification. In examining the sides of the lesions, most cases of calcification were single, and a few were multiple. As in Imani Moghadam's studies (25), most cases of Imani Moghadam's tissue calcifications have been reported as bilateral. While Scaf (59) mentioned soft tissue calcification mostly unilaterally, which is not similar to our results, there was no significant difference in the number of calcification cases between men and women. In this study, there was no significant relationship between the position and number of calcification cases and the age of the patients. In Imani Moghadam's study (25), 78.2% of tonsilloliths were multiple and more than two. Mesolella (27) also reported tonsilloliths with more frequency in clusters and multiples.

The use of panoramic radiography, which is routinely and widely prepared in dental clinics to check the condition of the teeth and jaw, is an easy, safe, and inexpensive way to detect soft tissue calcifications in the head and neck area. This can be effective in the early detection of underlying factors causing these calcifications. Dentists as well as head and neck doctors should be aware of these calcifications and make necessary referrals if necessary.

Considering that soft tissue heterotopic calcifications can be a warning sign for the onset of cerebrovascular diseases, salivary gland stones, lymph nodes, functional limitations, neurological disorders, and the development of clinical symptoms, by determining the prevalence of these heterotopic calcifications, dentists can be justified in examining panoramic radiographs so that they do not ignore any of the unusual calcifications and contribute to reducing the burden of more serious complications of the disease by timely referring patients to the doctor.

In order to make a correct diagnosis and prevent incorrect and additional treatments, it is necessary to know the prevalence of these cases in the regional population. The present study had limitations. Due to the fact that this study is based on radiography alone and lacks complete information about the systemic conditions and underlying diseases of the people, and due to the impact of some diseases on the prevalence of soft tissue calcification, conducting a study considering underlying diseases seems necessary. One of the limitations of this study is its lack of use of digital archives. For future studies, it is suggested to use digital archives to enable more accurate detection of calcifications by using contrast enhancement.

Conclusion

The findings of the study showed that the ossification of the stylohyoid ligament and the calcification of the tonsils were the most common among soft tissue calcifications in the head and neck region. In this study, the prevalence of soft tissue calcifications in the head and neck area was not related to the age and gender of the patients, except for the cases of calcification in the tonsils area, which were related to male gender. Most of the lesions were bilateral and single. The use of panoramic radiography, which is routinely and widely prepared in dental clinics to check the condition of the teeth and jaw, is an easy, safe, and inexpensive way to detect soft tissue calcifications in the head and neck area. This can be effective in the early detection of underlying factors causing these calcifications.

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