Original Article

Prevalence of Soft Tissue Calcifications in the Head and Neck Region: A Cone-Beam Computed Tomography Study

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ABSTRACT

Objective: The aim of this study was to detect the prevalence of soft tissue calcifications in the head and neck using cone beam computed tomography (CBCT) and to determine their clinical importance. **Subjects and Methods:** Soft tissue calcifications in the head and neck region were retrospectively evaluated in 1557 CBCT images obtained between 2013 and 2015. The findings were categorized as follows: tonsillolith (calcified tonsil), carotid artery calcification (CAC), sialolith (salivary stone), calcified triticeous cartilage (CTC), calcified lymph node (CLN), rhinolith, antrolith, calcification of the superior cornu of the thyroid cartilage (CSCTC), calcified stylohyoid ligaments (CSL), myositis ossifican, osteoma cutis, and intracranial calcification. A Chi-square test was performed for categorical variables. In the 1557 CBCT images, 520 (33.4%) contained had at least one soft tissue calcification in the head and neck region. **Results:** Tonsilloliths (18.8%) were the most prevalent soft tissue calcification, followed by CTC (5.8%), CAC (4.3%), intracranial calcifications (3.9%), CSL (3.7%), CSCTC (2.1%), osteoma cutis (1%), sialoliths (0.7%), antroliths (0.5%), myositis ossificans (0.4%), rhinoliths, and CLN (0.2%). **Conclusion:** There was a high prevalence of soft tissue calcifications in the head and neck region on CBCT images. Tonsilloliths were the most common type of calcification. CBCT imaging may aid the diagnosis and assessment of these calcifications.

Keywords: *Calcification, cone-beam computed tomography, head, neck, soft tissue*

Introduction

The deposition of calcium salts is limited to particular sites in skeletal tissues, including cartilage, bones, and teeth.[1] The accumulation of minerals in soft tissue without any organization is called heterotopic calcification, whereas organized accumulate are known as heterotopic ossification. Heterotopic calcifications are divided into three subgroups according to the mechanism of calcification, etiologies, and localizations: dystrophic, idiopathic, and metastatic.[2] Serum calcium and phosphate levels are normal in dystrophic calcification, which is seen in degenerated, diseased, or dead tissues. It is generally thought to occur following inflammation, trauma, or infectious diseases.[2] These calcifications are located in the head and neck region and are relatively common in the general population. Most of these calcifications are asymptomatic and diagnosed incidentally,[2] for example, on conventional imaging used in dentistry, especially panoramic radiography.[3] Conventional imaging provides a two-dimensional (2D) representation of a three-dimensional (3D) object. As many of the structures in the head and neck region are in close proximity to one another, identification of the exact location of an object is a major difficulty when diagnosing soft tissue calcifications on conventional imaging. The close

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proximity of structures in the head and neck region cause particular problems on panoramic radiographs, as they can give rise to distortion, magnification, superposition, and ghost images.[4] Thus, panoramic radiographs can lead to incorrect interpretations of a unilateral lesion as a bilateral one. Cone beam computed tomography (CBCT) can overcome this difficulty.[5]

Today, CBCT is widely used for maxillofacial imaging as a diagnostic modality for the head and neck region due to the relatively low radiation dose and high isotropic spatial resolution of osseous structures. Incidental findings, such as soft tissue calcifications, can be detected with the wide field of view (FOV) in CBCT. The type of calcification must then be determined, as well as the potential need for treatment. For an accurate diagnosis, the localization, number, shape, and distribution of soft tissue calcifications should be considered. The soft tissue anatomy must also be taken into account. When soft tissue calcifications adjoin bone, it can be difficult to determine whether the calcification is in bone or soft tissue. In such cases, the patient's history, a clinical examination, radiography at a different angle, or advanced imaging techniques may be useful.

Only a few studies have utilized CBCT images for the detection of incidental findings, such as soft tissue calcification and/or localized manifestations of systemic disease.[6-8] To the best of our knowledge, no such studies have been conducted in a Turkish population. Therefore, the aim of this study was to determine the prevalence of soft tissue calcifications in the head and neck region on CBCT images in this population.

Subjects and Methods

The study protocol was approved by the ethics committee of Gaziantep University (Decision No: 2017/233). This was a retrospective study of soft tissue calcifications in the head and neck region of 1557 patients (males, n = 798; females, n = 759) aged between 11 and 84 years. All CBCT images were obtained between 2013 and 2015 years period in a Turkish population. The patients were referred to the dentomaxillofacial radiology clinic for CBCT for various dental reasons. CBCT images in which the mandible, maxilla, and face were within the FOV were included in this study.

All CBCT images were acquired using a Planmeca Promax 3D (Helsinki, Oy, Finland) scanner, with Planmeca Romexis software (Helsinki, Oy, Finland) version 3.2.0 in standard resolution mode (voxel size: 0.4 mm^3; FOV: 16 × 5, 16 × 9, 16 × 16 cm). The presence, type, and side of the calcifications in the head and neck region were analyzed in multiplanar sections (axial, coronal, sagittal, and cross-section reformatted panoramic images). These features were evaluated according to age and gender.

The calcifications were classified as follows: tonsillolith (calcified tonsil), carotid artery calcification (CAC), sialolith (salivary stone), calcified triticeous cartilage (CTC), calcified lymph node (CLN), rhinolith, antrolith, calcification of the superior cornu of the thyroid cartilage (CSCTC), calcified stylohyoid ligament (CSL), myositis ossifican, osteoma cutis, and intracranial calcification.

Two oral and maxillofacial radiologists independently assessed the soft tissue calcifications: one with 3 years experience and the other with 7 years experience using a 24-in Ultrasharp LED TFT 24-inch monitor (Dell, Dell Inc., Round Rock, TX, USA). In cases of disagreement between the observers, consensus was reached by discussion. The brightness and contrast of all the acquired images were enhanced to improve visualization of possible soft tissue calcifications. The presence and characteristics of the soft tissue calcifications were recorded.

Intraobserver and interobserver reliability were evaluated by kappa statistics. SPSS software, version 20.0 (IBM SPSS Statistics for Windows, Armonk, NY, USA) was used to analyze the raw data. A Chi-square test was used for the categorical variables. A value of $P < 0.05$ was considered statistically significant.

Results

Intra- and inter-observer correlations were found exellent for all of the evaluations (0.92 and 0.85, respectively). Among the 1557 subjects, 520 (33.4%) (males, n = 285; females, n = 235) had at least one soft tissue calcification on the CBCT images of the head and neck region. The calcification was unilateral in 105 (60.7%) of 520 images. The mean age of the subjects without soft tissue calcifications was 35.25 ± 18.32 years whereas the mean age of those with soft tissue calcifications was 44.22 ± 16.04. The prevalence of soft tissue calcifications was higher in the older age group. As shown in Table 1, males had a significantly higher rate of soft tissue calcification as compared with that of females (35.71% vs. 30.96%) ($P < 0.05$). The results

Table 1: Distribution of soft tissue calcifications by gender

	Soft Tissue Calcifications			
Gender	Frequency n (%)	No n (%)	Yes n (%)	P
Female	759 (48.6)	524 (69.0)	235 (31.0)	0.047*
Male	798 (51.4)	513 (64.3)	285 (35.7)	
Total	1557	1037	520	

*According to Chi-square test, P<0.05

Table 2: Prevalence of soft tissue calcifications in cone-beam computed tomography (CBCT) scans

Soft Tissue Calcifications	*n* (%)
Tonsillolith	292 (18.8)
CTC	90 (5.8)
CAC	67 (4.3)
Intracranial Calcification	61 (3.9)
CSL	57 (3.7)
CSCTC	32 (2.1)
Osteoma Cutis	15 (1)
Sialoliths	11 (0.7)
Antrolith	8 (0.5)
Myositis Ossificans	7 (0.4)
CLN	3 (0.2)
Rhinolith	3 (0.2)

*CTC: calcified triticeous cartilage; CAC: carotid artery calcification; CSL: calcified stylohyoid ligament; CSCTC: calcified superior cornu of the thyroid cartilage; CLN: calcified lymph node.

Table 3: Prevalence of soft tissue calcifications according to side affected

Soft Tissue Calcifications	Unilateral *n* (%)	Bilateral *n* (%)	Total *n* (%)
Tonsillolith	180 (11.6)	112 (7.2)	292 (18.8)
CAC	74 (4.8)	16 (1)	90 (5.8)
CTC	34 (2.2)	33 (2.1)	67 (4.3)
CSL	29 (0.9)	28 (1.8)	57 (3.7)
CSCTC	9 (0.6)	23 (1.5)	32 (2.1)
Sialolith	11 (0.7)	0 (0)	11 (0.7)
CLN	1 (0.1)	2 (0.1)	3 (0.2)

*CTC: calcified triticeous cartilage; CAC: carotid artery calcification; CSL: calcified stylohyoid ligament; CSCTC: calcified superior cornu of the thyroid cartilage; CLN: calcified lymph node.

of the Chi-square analysis indicated that the frequency of intracranial calcifications and tonsilloliths was significantly higher in males, whereas CSCTC was more common among females.

Tonsillolith (18.8%) were the most prevalent type of soft tissue calcifications, followed by CTC (5.8%), CAC (4.3%), intracranial calcification (3.9%), CSL (3.7%), CSCTC (2.1%), osteoma cutis (1.0%), sialolith (0.7%), antrolith (0.5%), myositis ossificans (0.4%), CLN (0.2%), and rhinolith (0.2%) [Table 2]. When all the images were considered, tonsillolith accounted for about 56% of all calcifications.

As shown in Table 3, the side of the soft tissue calcifications was as follows: unilateral tonsillolith, 11.6%; bilateral tonsillolith, 7.2%; unilateral CAC, 3.3%; bilateral CAC, 1.0%; unilateral sialolith, 0.7%; unilateral CTC, 3.7%; bilateral CTC, 2.1%; unilateral CSL, 1.9%; bilateral CSL, 1.8%; unilateral CLN, 0.07%; bilateral CLN, 0.13%; unilateral CSCTC, 1.6%; and bilateral CSCTC, 1.5%.

Discussion

The present study demonstrated the prevalence, type, and side (unilateral or bilateral) of soft tissue calcifications in a Turkish population on CBCT images in the head and neck region. To the best of our knowledge, no publishing studies have reported all these types of calcifications in a Turkish population using CBCT.

Soft tissue calcifications in the head and neck region are relatively common in the general population and are generally detected in routine radiographic examinations as incidental findings.[9] Although they may be symptomatic in some cases, they remain asymptomatic for many years in other cases. The majority of previous studies used conventional 2D imaging modalities to detect soft tissue calcifications.[2,3,10] A plausible explanation for the relatively large percentage of these calcifications in our study may be the superior imaging capabilities of CBCT and the distortion, magnification, and superposition of 2D imaging techniques. There also may be the lack of medical history of the patients in the database.

Previous research reported that older age was correlated with an increased incidence of calcifications.[10] Previous studies have examined particular calcifications,[4,11] but to the best of our knowledge, the whole calcification types of the head and neck region have not been investigated. In the literature, it was concluded that conventional imaging methods were inadequate not only in the detection of calcifications but also in the diagnosis of the affected structures.[4,12]

In our study, the features of the calcifications were variable. The 3D nature of CBCT imaging provided superior diagnostic imaging ability as compared with that of conventional 2D radiographic techniques. Based on panoramic images, previous research on the incidence of soft tissue calcifications and ossifications reported a prevalence of between 2% and 5%.[13] Nunes *et al*.[14] stated in their CBCT study that the incidence of soft tissue calcifications was 15% in the mandibular region in a Brazilian population. This rate was similar to that found in another CBCT study, which reported an incidence of 25.9% in an Iran population.[11] In another recent CBCT study, 62.6% of subjects had at least one type of calcification.[15] In the present retrospective CBCT imaging study, the incidence of at least one type of calcification in the head and neck region was 33.4%. These different results may be caused by ethnical changes and the sample characteristics and size.

Soft tissue calcifications/ossifications are frequently observed in individuals older than 40 y, although they are also found in children.[10,11,14] In two previous studies,

the mean age of patients with mandibular soft tissue calcifications was 44.98 ± 11.24 years and 51.7 ± 18.03, respectively.[11,14] In our study, the mean age of the patients with calcifications was 44.17 ± 1z6.04 years, and patients (mean age) with calcifications were significantly older than those without calcifications. In contrast to the literature,[14,15] soft tissue calcifications in the present study were related to both age and genders. According to our results, the prevalence of soft tissue calcifications increased with age. Furthermore, the rate of soft tissue calcifications was higher in males than in females. In addition, the frequencies of intracranial calcifications and tonsilloliths were significantly higher in males, whereas the frequency of CSCT was higher in females. There was no significant relationship between other types of calcifications and gender.

In a study based on 3028 panoramic radiographs, tonsillolith, CAC, sialolith, and CLN rates were 56%, 29%, 11%, and 4%, respectively.[10] In another panoramic radiography study, the prevalence of tonsilloliths was 8.14%.[16] According to Monsour *et al*.,[3] the most frequent calcification/ossification were CSL, CLN, and sialolith. In CT images of 357 trauma patients, the CAC, tonsillolith, and CSL rates were 22.9%, 32.2%, and 24.3%, respectively.[6] On CBCT scans with different FOV sizes, elongated styloid processes and tonsilloliths were the most common types of calcification.[15] In our study, tonsilloliths (18.8%) were the most common type of calcification, followed by CTC (5.8%), CAC (4.3%), intracranial calcification (3.9%), CSL (3.7%), CSCTC (2.1%), osteoma cutis (1%), sialolit (0.7%), antrolith (0.5%), myositis ossificans (0.4%), rhinolith, and CLN (0.2%). When all the images were considered, tonsilloliths accounted for approximately 56% of all calcifications and 18.8% of the total images.

In the study of Khojastepour *et al*.,[11] 62.8% of total calcifications were unilateral and 37.2% were bilateral. Similar this research, in the present study, 59% of calcifications were unilateral and 41% were bilateral.

More than one calcification was a relatively common finding in our study. Although this may have little clinical significance, it could be an indicator of underlying pathology and present a risk for arterial calcification. Therefore, single and multiple calcifications in images should alert the clinician to the need for close patient follow-up.

A limitation of this study was that the radiological evaluations of CBCT images were performed retrospectively. Thus, no information was available on the medical histories of the subjects, and only data on age, gender, date of scanning, and type of scanning were available. Another limitation was the lack of clinical data and equipment that could be used for differential diagnosis of the calcifications. Finally, this study was conducted in a single center, and the incidence of calcifications and associated risk factors may differ in other populations. In future research, the age distributions and medical histories of patients may be correlated with each calcification type.

Conclusions

The prevalence of soft tissue calcifications was high in the head and neck region on CBCT images, with tonsilloliths the most common type of calcification. We emphasize that radiologists need to have sufficient knowledge of the anatomy and clinical importance of soft tissue calcifications, including the different types of calcifications, found in the maxillofacial region. Although CBCT can aid the detection of soft tissue calcifications, an ultrasonographic evaluation is recommended for a definitive diagnosis of soft tissue calcifications in the head and neck region.

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Conflict of interest

The authors declare that they have no conflict of interest.

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