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ARAŞTIRMA MAKALESİ/ORIGINAL ARTICLE

Evaluation of Maxillofacial Soft Tissue Calcifications in Edentulous Patients on Panoramic Radiographs

Dişsiz Hastaların Panoramik Radyograflarında Yumuşak Doku Kalsifikasyonlarının Değerlendirilmesi

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ABSTRACT

Aim: It is aimed to evaluate the prevalence, and types of soft tissue calcifications (STCs) on panoramic radiographs of edentulous patients.

Material and Methods: 1308 images were randomly selected from patients who applied to Necmettin Erbakan University for various dental problems in 2020 and 2021. In these radiographs, tonsillolith, sialolith, calcified atherosclerotic plaque (CAP), and stylohyoid ligament calcification (SLC), calcified lymph node, phleboliths, antroliths, rhinoliths, and triticeous and thyroid cartilage calcifications were evaluated. Data were categorized according to gender, systemic disease and calcification type. Descriptive statistics were determined for all parameters. The status of the data according to gender, age group and systemic disease were analyzed by chi-square test ($p<0.05$).

Results: Soft tissue calcifications was found in 478 (36.6%) of 1308 patients. Calcified atherosclerotic plaque was detected in 30.4%, stylohyoid ligament calcification in 27.0%, calcified lymph node in 16.1%, tonsillolith in 15.4%, tritiseous cartilage calcification in 12.3%, sialolith in 0.5%, arteriosclerosis in %0.3 of patients. There was a significant difference when soft tissue calcifications are evaluated according to age groups ($p<0.05$). However, there was no difference in the appearance of soft tissue calcifications based on gender or systemic disease ($p>0.05$).

Conclusion: Calcified atherosclerotic plaque and stylohyoid ligament calcification were detected most frequently, and sialolith and atherosclerosis were detected least on panoramic radiography. Physicians should be able to recognize incidentally detected soft tissue calcifications during radiographic examination and distinguish them from normal anatomical structures and pathologies in the relevant region.

Keywords: Calcification, Elderly, Panoramic, Soft Tissue

ÖZ

Amaç: Dişsiz hastaların panoramik radyografilerinde yumuşak doku kalsifikasyonlarının prevalansını ve tiplerini değerlendirmek amaçlanmıştır.

Gereç ve Yöntemler: 2020 ve 2021 yıllarında kliniğimize çeşitli diş problemleri için başvuran hastalardan rastgele seçilen 1308 görüntüde tonsillolit, sialolith, kalsifiye aterosklerotik plak, stylohyoid ligament kalsifikasyonu, kalsifiye lenf nodu, flebolit, antrolit, rinolit, tritiköz ve tiroid kıkırdak kalsifikasyonları değerlendirildi. Veriler cinsiyet, sistemik hastalık ve kalsifikasyon tipine göre kategorize edildi. Tüm parametreler için tanımlayıcı istatistikler belirlendi. Verilerin cinsiyet, yaş grubu ve sistemik hastalığa göre durumu ki-kare testi ile analiz edildi ($p<0,05$).

Bulgular: 1308 hastanın 478'inde (%36,6) yumuşak doku kalsifikasyonu saptandı. Hastaların %30,4'inde kalsifiye aterosklerotik plak, %27,0'sinde stylohyoid ligament kalsifikasyonu, %15,4'ünde tonsillolit, %13,9'unda kalsifiye lenf nodu, %12,3'ünde tritisöz kıkırdak kalsifikasyonu, %0,5'inde sialolit, %0,3'ünde arterioskleroz tespit edildi. Yaş gruplarına göre yumuşak doku kalsifikasyonları değerlendirildiğinde istatistiksel olarak anlamlı fark olduğu gözlendi ($p<0,05$). Ancak yumuşak doku kalsifikasyonları varlığı ile cinsiyet veya sistemik hastalık arasında fark tespit edilmedi ($p>0,05$).

Sonuç: Panoramik radyografide en sık kalsifiye aterosklerotik plak ve stylohyoid ligament kalsifikasyonu, en az sialolith ve ateroskleroz tespit edildi. Hekimler tesadüfen saptanan yumuşak doku kalsifikasyonlarını radyografik muayene sırasında tanıyabilmeli ve ilgili bölgedeki normal anatomik yapılardan ve patolojilerden ayırt edebilmelidir.

Anahtar Kelimeler: Kalsifikasyon, Yaşlı, Panoramik, Yumuşak Doku

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INTRODUCTION

The twentieth century marked a significant turning point in the demographic landscape of the world, particularly in terms of age distribution within the global population. Notably, there has been a substantial increase in both the numerical and proportional representation of the elderly population, particularly in the latter half of the century. This trend is also evident in Turkey, where the proportion of elderly individuals in the overall population has been steadily rising each year. In the span of just two decades, the percentage of elderly individuals in Turkey has risen from 4% to 6% (1).

Tooth loss is a condition that profoundly impacts an individual's quality of life, affecting various aspects such as speech, chewing ability, nutrition, social interactions, and even emotional well-being (2). Although aging itself is not a direct cause of tooth loss, functional limitations and the heightened susceptibility to dental and systemic diseases that come with advancing age can make elderly patients more prone to experiencing complete tooth loss (edentulism) (2, 3). For successful treatment with removable prostheses in edentulous patients, it is crucial to assess the suitability of the underlying tissue bed where the prosthesis will be placed. Radiological examinations play a vital role in evaluating the condition of the tissue bed prior to treatment. Unfortunately, abnormalities in edentulous jaws often go unnoticed as they may not manifest noticeable clinical signs or symptoms. These abnormalities encompass various soft tissue calcifications (STCs), including tonsilloliths, sialoliths, stylohyoid ligament calcifications (SLCs), calcified lymph nodes, calcified atherosclerotic plaques (CAPs), arteriosclerosis, phleboliths, antroliths, rhinoliths, and calcifications of the triticeous and thyroid cartilage (4). Panoramic radiography, a commonly employed diagnostic tool for detecting abnormalities during the radiographic examination of patients prior to treatment, holds significant importance in the diagnosis and treatment planning of numerous oral and maxillofacial diseases in dental practice. Furthermore, it is indispensable in the evaluation of edentulous patients before the fabrication of complete dentures (5). The objective of this study was to assess the prevalence and characteristics of STCs identified in routine panoramic radiographs of edentulous elderly patients.

MATERIALS AND METHODS

This study was approved by the Necmettin Erbakan University Research Ethics Committee on 28.10.2021 (Approval number 2021/11-91) and was conducted in accordance with the Declaration of Helsinki. Each individual included in the study signed a detailed informed consent form.

Panoramic images of edentulous patients who presented for various resasons to the Necmettin Erbakan University Faculty of Dentistry, Department of Dentomaxillofacial Radiology between January 2020 and October 2021 were selected for the study. Panoramic radiographs were taken with a Morita Veraviewepocs 2D panoramic unit (J Morita MFG Corp., Kyoto, Japan) at 60-70 kVp, 5-7 mA and 6-8 s exposure times according to the manufacturer's recommendations. All data were evaluated by one maxillofacial radiologist. To assess intraobserver agreement, 100 random panoramic images were reevaluated 3 weeks later. Only diagnostically acceptable images of edentulous patients were used in this study. Panoramic images with low image quality, artifacts, or resection in the maxillofacial

region, and images of individuals who had prior cancer surgery or were younger than 65 years old were excluded. In this study, 1073 images with inclusion criteria out of 1200 scanned images were evaluated.

The distribution of data was analyzed with descriptive statistics, and correlations with gender or systemic disease (diabetes and hypertension) were analyzed using the chi-square test. IBM SPSS Statistics version 22.0 was used for analysis. A p-value less than 0.05 was accepted as the statistical significance level.

RESULTS

For intra-observer agreement related to the STCs detection, the κ value is 0.937.

In this study, 1308 panoramic radiographs of completely edentulous patients (659 females age 72.01 ± 8.12 and 649 males age 72.26 ± 8.92) age 65–92 (70.17 ± 8.68) were evaluated. No STCs were detected in 830 (63.4%) of the patients. A total of 559 STCs were detected in 478 (36.6%) of the patients. Of these detected STCs, 291 were in female patients and 268 in male patients. There was no statistically significant relationship between calcification type and gender (p=0.765). However, there was a significant difference when STCs were evaluated according to age group (Table 1).

Table I. Statistical analysis by age groups and soft tissue calcifications

		Age Groups			Total	p value
		65-74	75-84	85 +		
Frequencies	No STC	168	167	495	830	0.004*
	One type STC	24	73	305	402	
	Two type STC	3	17	51	71	
	Three type STC	1	1	3	5	
Total		196	258	854	1308	

STC: soft tissue calcifications
χ2 Test, *p>0.05 There is a statistical difference between age groups and STC

Calcified atherosclerotic plaques (Figure 1B and C) were detected in 30.4% of patients, SLCs (Figure 2) in 27.0%, tonsilloliths (Figure 1C and Figure 2) in 15.4%, calcified lymph nodes (Figure 1B and Figure 2) in 13.9%, triticeous cartilage calcifications (Figure 1A) in 12.3%, sialoliths (Figure 3) in 0.5%, and arteriosclerosis (Figure 4) in 0.3%. No antroliths, rhinoliths, thyroid cartilage calcifications, or phleboliths were detected.

CAP was the most prevalent STC, and sialoliths and arteriosclerosis were the least (Figure 5).

A single calcification was found in 402 individuals, while two distinct types of calcifications were found in 71 patients. Furthermore, three or more types of calcifications were detected in 5 individual of the patients (Figure 6).

Risk factor diseases for STCs were recorded from the anamnesis forms. Diabetes was present in 48 of 190 patients and hypertension in 43 patients. However, no statistically significant relationship was found between the presence of STCs and systemic disease (p=0.266, p=0.132).

No statistically significant relationship was found between all calcification types and diabetes or hypertension (p=0.542, p=0.61). However, although there was no statistically significant difference, more STCs were observed in hypertensive patients.

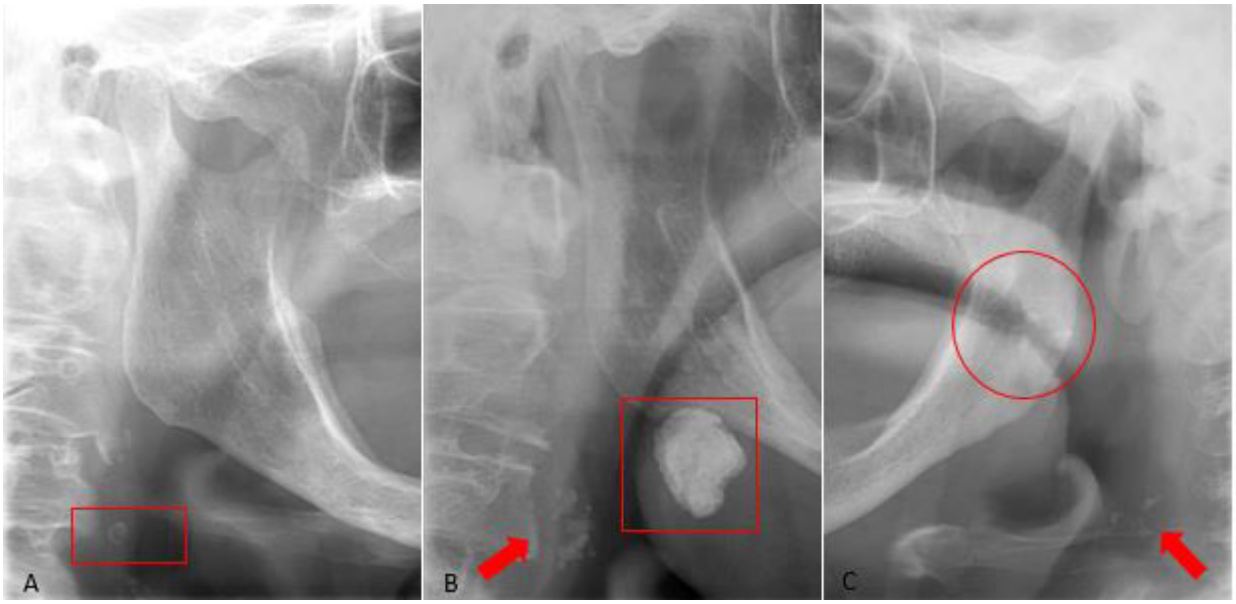


Figure 1. Soft tissue calcifications samples

A. Triticeous cartilage calcification (rectangle) below the hyoid greater horn.

B. Lymph node calcification(square), and CAPs(red arrow)

C. Irregularly shaped CAPs(red arrow), Multiple, rounded tonsilloliths superposed on the left ramus(circle)

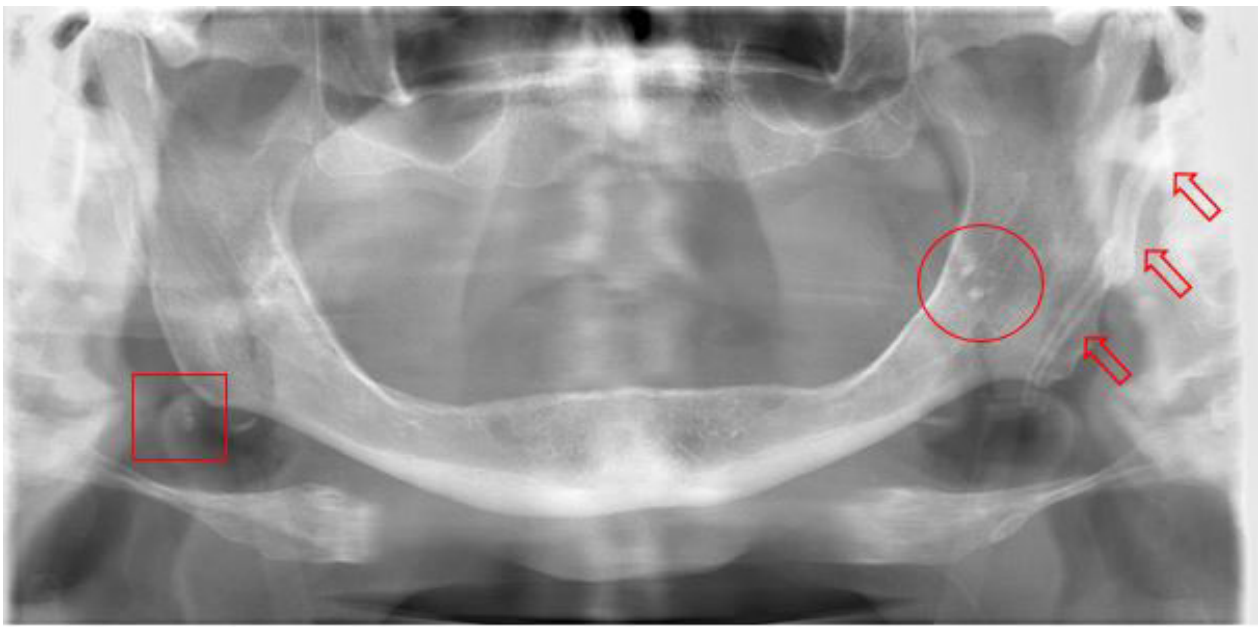


Figure 2. Soft tissue calcifications samples

Stylohyoid ligament calcification (arrows), tonsilloliths(circle), lymph node calcifications (square)

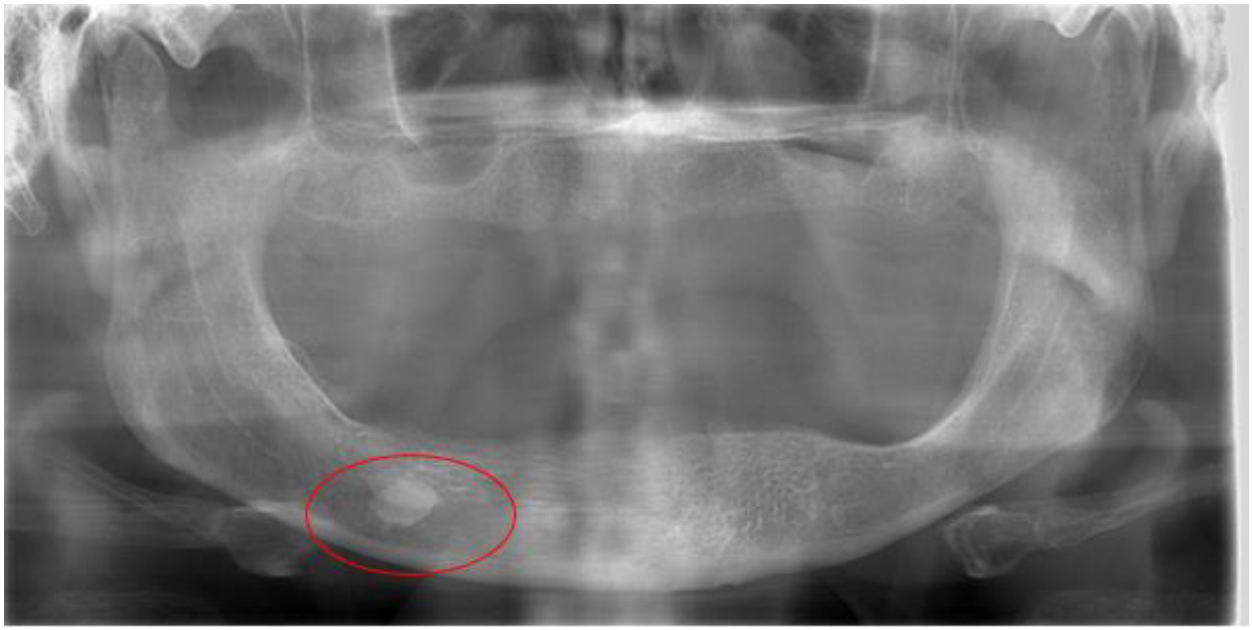


Figure 3. Sialolith (ellipse) superposed on the body of the mandible

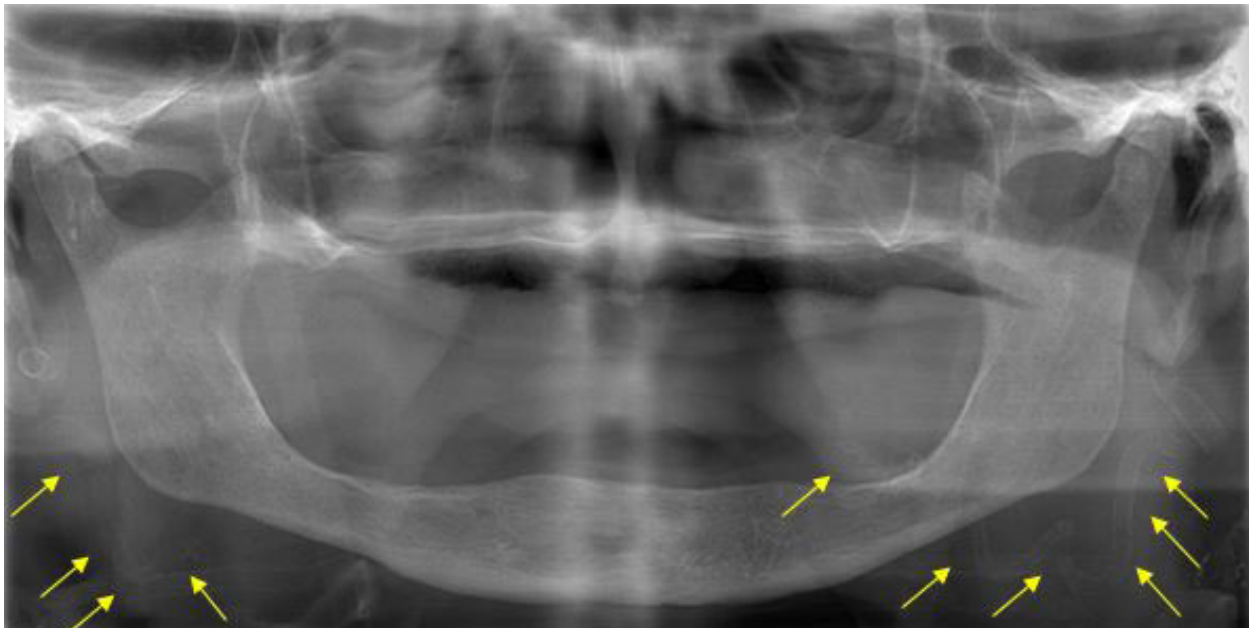
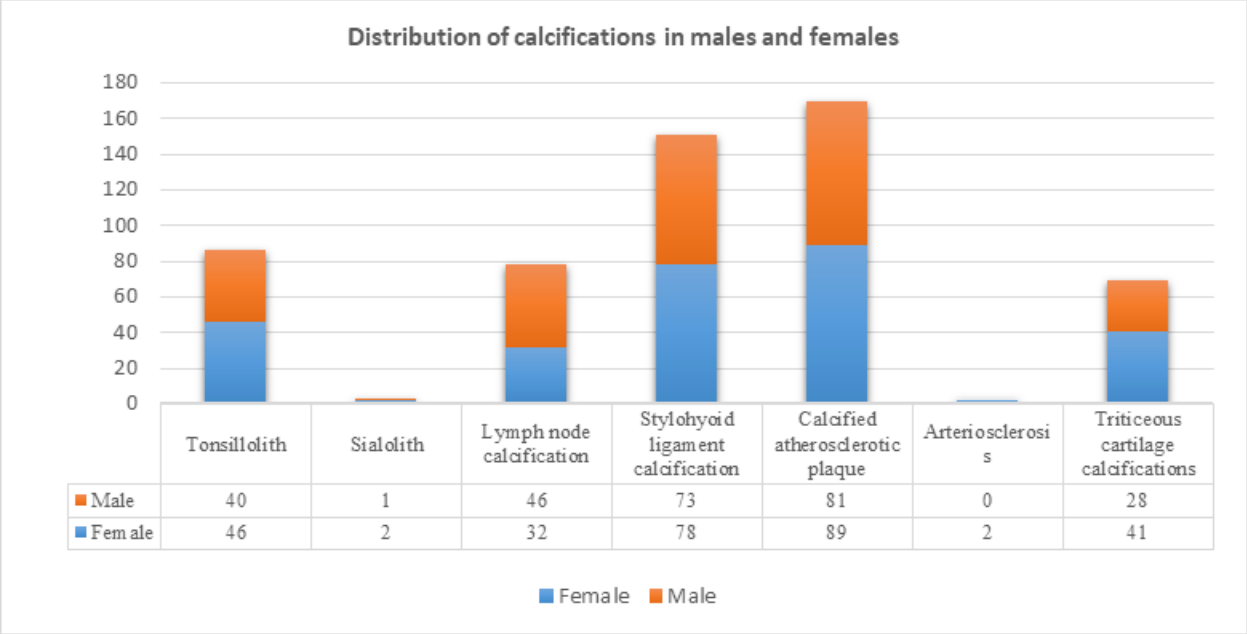


Figure 4. Yellow arrows showing the arterioscleros (rail track or pipe-like) radiopacities bilaterally along the ramus, and below the body of the mandible



	Tonsillolith	Sialolith	Lymph node calcification	Stylohyoid ligament calcification	Calcified atherosclerotic plaque	Arteriosclerosis	Triticeous cartilage calcifications
Male	40	1	46	73	81	0	28
Female	46	2	32	78	89	2	41

Figure 5. Distribution of soft tissue calcifications by gender

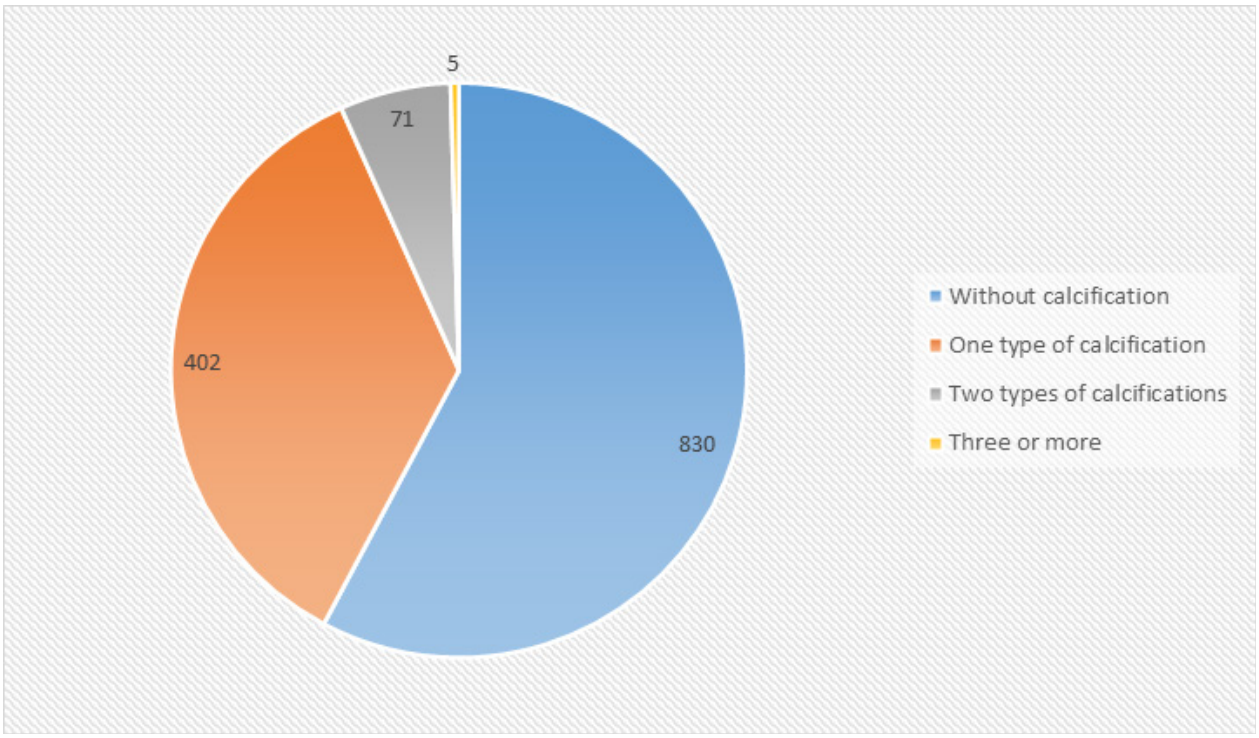


Figure 6. Distribution of soft tissue calcifications by frequency

DISCUSSION

Several studies have been conducted to investigate the prevalence of positive radiographic findings, such as impacted teeth, impacted tooth roots, cysts or tumors, foreign bodies, and the proximity of the mental foramen to the alveolar crest in edentulous patients (5-7). These studies primarily utilized panoramic radiographs as the imaging modality of choice. Panoramic radiography, being a simple and well-tolerated method, particularly among elderly patients, is considered practical for assessing various anatomical structures, including alveolar crest resorption, maxillary sinuses, mandibular canal, mental foramen, as well as facilitating examination of a large number of patients efficiently (8).

Similar to the aforementioned pathologies, soft tissue calcifications within the head and neck region are often detected during routine dental examinations and panoramic radiographic evaluations. The prevalence of soft tissue calcifications or ossifications is relatively common, and accurate diagnosis is crucial in differentiating benign lesions from pathological conditions. The reported incidence of soft tissue calcifications on panoramic radiographs ranges from 2.61% to 19% (9-11). In this study however, the prevalence was found to be 36.6% higher than the literature. Furthermore, there is considerable variation in the distribution of different types of calcifications. For instance, Sutter et al. observed multiple calcifications in 1.9% of cases, whereas our study reported a lower frequency of 0.46% for such occurrences (11).

Garay et al. (10), Haghighat et al. (12), İçoz and Akgünlü (13), found that the presence of STCs increased with age. Consistent with these studies, it was observed in this study that the presence of STCs increased with age.

It has been reported that CAP is detected in the range of 4.8-5.7% on panoramic radiography (11, 14, 15). In this study, it was seen more at 12.99%. It has been reported that it is typically more common in men or that there is no discernible difference between the sexes. In this study, it was more common in women, similar to the studies of Ohba et al. (15) and Bayer et al. (16).

Systemic conditions such as diabetes mellitus, hypertension and hyperlipidemia are known to be risk factors for calcified atherosclerotic plaque (17). In another study, 22.3% of patients with atherosclerotic plaque had hypertension and 17.2% had Type II diabetes (14). In this study, 21.5% of patients with calcified atherosclerotic plaque had hypertension at a similar rate; and Type II diabetes were found to be 25.3% more.

Positive results, such as 63.44-81.5%, were obtained in sonographic examinations performed to confirm the carotid artery calcification diagnosed on panoramic radiography (14, 18). Duplex sonography and angiography provide ideal imaging for the diagnosis of atherosclerotic plaque. However, their routine use is not possible due to both the cost and the high radiation dose in CT (computerized tomography) assisted angiography (19). Panoramic radiographs are routinely taken due to dental complaints and have high diagnostic values for calcified atherosclerotic plaque. In this case, it is crucial for dentists to diagnose calcified atherosclerotic plaque, which is a risk factor for stroke, and to refer the patient to a medical doctor.

The prevalence of SLC on panoramic radiography has been reported in the literature in the range of 1.4-19.7% (20, 21). In this study, it was found to be 11.54% and

was observed more frequently in women than in men (22, 23). Many studies have indicated that it is bilateral and increases with age (21, 24, 25). In this study, it was mostly seen bilaterally and in older age.

Lymph node calcification may occur after tuberculosis, sarcoidosis, rheumatoid arthritis, cat scratch disease, neoplastic metastases, and radiotherapy. It has been reported that lymph node calcifications are observed with a frequency of 0.1-3.6% (10, 11). In this study, it was found to be 0.6%, similar to the literature.

Tritiseous cartilage calcifications are usually distinguished from CAPs by their well-circumscribed, oval and smooth structure and their more medial location (26, 27). Their incidence on panoramic radiography was reported as 8.6-10.6% (27, 28). In this study, it was seen less frequently with a rate of 0.53%. Similar to previous studies, it was observed more in women.

Differential diagnosis of tonsilloliths with phleboliths, osteosclerosis, enostosis and sialoliths should be made due to their localization (29). It has been reported to be observed in the range of 1.45-8.14% on panoramic radiography (10, 11, 30). In this study, tonsiloliths was found to be 0.66%. Consistent with other studies that state there was no difference between the sexes, it was seen at similar rates in men and women. There are few studies indicating that its incidence is not related to age (31). It has been reported that it mostly increases with age (30, 32), which our study's findings also confirm.

Sialoliths occur more in the submandibular gland than in the parotid gland, because the glandular secretion is more mucous, the pH is higher due to the increase in the concentration of hydroxyapatite and phosphatase, and the Wharton's canal is curved, narrow and long gland (33). It was reported to be seen with a frequency of 0.1-0.9% on panoramic radiographs (11, 19, 20) and in this study it was seen with a frequency of 0.22%. Just occlusal radiography-confirmed sialoliths were used in the study.

Calcification of the tunica media of the vessel, described by Möckenberg in 1903, is often seen in the extremities, but also in the head and neck region (34, 35). Lanzer et al. reported the prevalence at 0.5% (36). In this study, it was found to be 0.15%, which is close to the other studies in the literature, but at a lower rate. While it has been reported in the literature that it is more common in men than in women, our study reported no cases among men (34).

In the literature, it has been reported that phleboliths are seen in the range of 0.1% to 17.4% in panoramic imaging (37, 38). However, phleboliths was not detected in this study. Bayramov et al. (39) evaluated STCs in CBCT and found 2.6% anthrolith and 0.8% rhinolith, but they were not detected in this study. These differences may be the result of the different populations and age groups and the use of different imaging methods.

Several limitations should be acknowledged in our study. Firstly, the evaluation was based solely on two-dimensional images obtained from panoramic radiographs, without the benefit of a comprehensive clinical examination. This limitation restricts our ability to make precise confirmations and may introduce uncertainties in the interpretation of certain lesions. Moreover, panoramic radiography, being a two-dimensional imaging technique, imposes inherent limitations on the detailed evaluation of certain anatomical conditions or pathologies. In circumstances when a more extensive evaluation is required, three-dimensional tomographic

imaging may be indicated. Nevertheless, it is important to note that three-dimensional imaging does not have routine indications for every patient. Therefore, the present study relied on panoramic radiography, which is more commonly used for routine purposes and deemed appropriate for our research objectives.

CONCLUSION

Among the observed soft tissue calcifications (STCs) in the examined sample, calcified atherosclerotic plaques (CAPs) were found to be the most prevalent, surpassing other types of STCs. However, lymph node calcifications were an exception, exhibiting a different pattern. It was observed that women generally had a higher incidence of STCs, except for lymph node calcifications, when compared to men. Furthermore, a positive correlation was identified between the prevalence of STCs and increasing age.

Based on these findings, digital panoramic radiographs demonstrate potential as cost-effective and low-radiation diagnostic tools, particularly for the initial assessment of STCs.

Conflict of Interest

There is no conflict of interests.

Financial Support

There is no funding for this study.

Ethical Decleration

This study was approved by the Necmettin Erbakan University Research Ethics Committee on 28.10.2021 (Approval number 2021/11-91) and was conducted in accordance with the Declaration of Helsinki. Each individual included in the study signed a detailed informed consent form.

Author's Contributions

Concept: AA, Design: AA, Data collection and entry: AHC, AA, Analysis and interpretation: AA, AHC, Literatur search: AA, AHC, Writing: AA, AHC, Critical review: AA.

This study was presented at the Sivas Cumhuriyet University 1st International Dental Congress on November 23-25, 2021 with 500 samples.

The paper has not been sent to any other journal

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