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Corresponding author:
Marilisa Carneiro Leão Gabardo
E-mail:
marilisagabardo@gmail.com

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Calcifications in soft tissues of the head and neck region in a sample of Brazilian adults

Calcificaciones en tejidos blandos de la región cabeza y cuello en una muestra de adultos brasileños

Calcificações em tecidos moles da região da cabeça e pescoço em uma amostra de adultos brasileiros

Prescila Mota de Oliveira Kublitski[1], *Lizandra Cristina Hanke Agnes Pereira*[1], *Giuliana Martina Bordin*[1], *Carlos Eduardo Edwards Rezende*[1], *Adriane Sousa de Siqueira*[1], *Marilisa Carneiro Leão Gabardo*[1]

ABSTRACT

Objective: To identify calcifications in the soft tissues of the head and neck region in digital panoramic radiographs of Brazilian adults. **Materials and methods:** In this cross-sectional study, 384 examinations of individuals of both sexes, aged between 18 and 80 years, were analyzed for carotid artery calcifications, sialoliths, phleboliths, tonsilloliths, anthroliths, calcifications of the trityceous cartilage, calcifications of the styloid ligament and calcified lymph nodes. The association with sex and age was also studied. Data were analyzed using SPSS® version 23.0, with a significance level set at 5%. **Results:** Calcifications were identified in 53 examinations (13.80%). Styloid ligament calcification was observed in 24 cases (6.20%), followed by anthroliths (2.40%). Sialoliths and tonsilloliths were present in 6 cases each (1.60%). No calcified lymph nodes or phleboliths were identified. Despite the lack of significant association with sex and age ($p > 0.05$), females, white individuals and those in the fourth decade of life were more frequently affected. **Conclusions:** The frequency of calcifications in this sample was high, particularly for stylohyoid ligament calcifications and anthroliths, although no associations with sex and age were found.

Keywords: panoramic radiography; physiologic calcification; radiology.

RESUMEN

Objetivo: Identificar calcificaciones en los tejidos blandos de la región de la cabeza y el cuello en radiografías panorámicas digitales de adultos brasileños. **Materiales y métodos:** En este estudio transversal, se analizaron 384 exámenes de individuos de ambos sexos, con edades entre 18 y 80 años, en busca de calcificaciones de la arteria carótida, sialolitos, flebolitos, tonsilolitos, antrólitos,

[1] Universidade Positivo, School of Health Sciences. Curitiba, Brazil.

calcificaciones del cartílago tritíceo, calcificaciones del ligamento estilohioideo y ganglios linfáticos calcificados. También se investigó la asociación con el sexo y la edad. Los datos se analizaron utilizando SPSS® versión 23.0, con un nivel de significancia establecido en un 5 %. **Resultados:** Se identificaron calcificaciones en 53 exámenes (13,80 %). La calcificación del ligamento estilohioideo se observó en 24 casos (6,20 %), seguida por antrólitos (2,40 %). Los sialolitos y tonsilolitos se presentaron en 6 casos cada uno (1,60 %). No se identificaron ganglios linfáticos calcificados ni flebolitos. A pesar de la falta de asociación significativa con el sexo y la edad (p > 0,05), las mujeres, los individuos blancos y aquellos en la cuarta década de vida fueron más frecuentemente afectados. **Conclusiones:** La frecuencia de calcificaciones en esta muestra fue alta, particularmente para las calcificaciones del ligamento estilohioideo y antrólitos, aunque no se encontraron asociaciones con el sexo y la edad.

Palabras clave: radiografía panorámica; calcificación fisiológica; radiología.

RESUMO

Objetivo: Identificar calcificações nos tecidos moles da região da cabeça e pescoço em radiografias panorâmicas digitais de adultos brasileiros. **Materiais e métodos:** Neste estudo transversal, 384 exames de indivíduos de ambos os sexos, com idades entre 18 e 80 anos, foram analisados quanto a calcificações na artéria carótida, sialólitos, flebólitos, tonsilólitos, antrolitos, calcificações da cartilagem tritícea, calcificações do ligamento estiloide e linfonodos calcificados. A associação com sexo e idade também foi investigada. Os dados foram analisados usando o SPSS® versão 23.0, com um nível de significância de 5 %. **Resultados:** Foram identificadas calcificações em 53 exames (13,80 %). A calcificação do ligamento estiloide foi observada em 24 casos (6,20 %), seguida por antrolitos (2,40 %). Sialólitos e tonsilólitos ocorreram em 6 casos cada (1,60 %). Não foram identificados linfonodos calcificados ou flebólitos. Apesar da falta de associação significativa com sexo e idade (p > 0,05), as mulheres, os indivíduos brancos e aqueles na quarta década de vida foram mais frequentemente afetados. **Conclusões:** A frequência de calcificações nessa amostra foi alta, particularmente para calcificações do ligamento estilo-hioideo e antrolitos, embora não tenham sido encontradas associações com sexo e idade.

Palavras-chave: radiografia panorâmica; calcificação fisiológica; radiologia.

INTRODUCTION

Tissue calcification is a biological process involving mineral deposition near cells. This process is considered physiological in structures like teeth and bones but pathological in soft tissues. Research suggests a common pattern of development for calcifications in various human tissues, implying the involvement of inflammatory factors or metabolic imbalances (1).

In the general population, calcifications can indeed be found in various forms, such as kidney stones (2) and gallstones (3). Specifically in the head and neck region, there are specific types of calcifications, including: carotid artery calcification (atheromas) (4-9), sialoliths (5-8, 10), phleboliths (7, 8), tonsilloliths (5-8, 10, 11). anthroliths (5, 7), calcification of the triticeal cartilage (5, 6, 8), calcification of the stylohyoid ligament (5-7, 12), and calcified lymph nodes (5-8, 10).

Most calcifications in the head and neck region are asymptomatic and exhibit variations across populations, including Turks (4, 5), Brazilians (8), Austrians (10), Portuguese (12), and Poles (9). These calcifications are important radiographic findings that can serve as diagnostic markers of systemic disorders, such as cardiovascular conditions (6, 8).

Regarding the diagnostic methods used to identify the calcifications mentioned, three-dimensional methods such as ultrasound and computed tomography are noted for their higher accuracy (13, 14).

However, panoramic radiography, commonly employed as a routine examination, offers distinct advantages. It covers both sides of the face and both dental arches in a single examination, making it a practical option for initial screenings. Calcifications appear as radiopaque images, highlighting their presence and aiding in the identification of changes (5, 8, 10, 12).

In this context, this study aimed to identify the presence of calcifications in the soft tissues of the head and neck region using digital panoramic radiographs from a sample of adults attending a private Brazilian university. Additionally, the study sought to investigate the association between these calcifications and the demographic profiles of the individuals.

MATERIALS AND METHODS

This study was approved by the institution's Human Research Ethics Committee, under registration CAAE 94846918.5.0000.0093, opinion no. 2,805,133. All participants signed the Free and Informed Consent Form.

The study design was cross-sectional, utilizing digital panoramic radiographs obtained from the image bank of the Radiology service at a private university in Curitiba, Paraná, Brazil. Participants, of both sexes, aged between 18 and 80, who received treatment between October 2018 and February 2020 (n = 1047), were eligible. A subsequent search for these patients' electronic medical records identified 324 individuals who lacked a signed informed consent form or had incomplete demographic data. Additionally, 339 exams were excluded due to suboptimal image quality, as assessed using the criteria by Sabarudin and Tiau (15). Consequently, the convenience sample consisted of 384 exams. Demographic variables included gender (male or female) and age, categorized into three groups: 18-27 years, 28-35 years, and 36-80 years.

All panoramic radiographs evaluated in this study were performed by a single operator using the Orthophos XG5 equipment (Sirona Dental Systems GmbH, Bensheim, Germany). Exposure factors of 73 kV and 15 mA were used, with an image acquisition time of 14.1 seconds. The images were evaluated by two calibrated examiners (Cohen's Kappa = 0.88); one of them being the reference standard (radiologist with 11 years of experience). The radiographs were analyzed under partial darkness in the room, on the same monitor, at a standardized distance of 45 cm (16), without time restrictions for the observers' analyses.

The identification of calcifications was conducted following the method proposed by Sutter et al. (10), which involved mapping the main areas where calcifications are typically found. The calcifications of interest in this study (carotid artery calcification, sialoliths, phleboliths, tonsilloliths, anthroliths, calcification of the triticeal cartilage, calcification of the stylohyoid ligament and calcified lymph nodes) were recorded as absent, present or not evaluated; when present, they were further classified as unilateral or bilateral. Figure 1 illustrates examples of images suggestive of calcification of the stylohyoid ligament (A) and anthrolith (B), respectively.

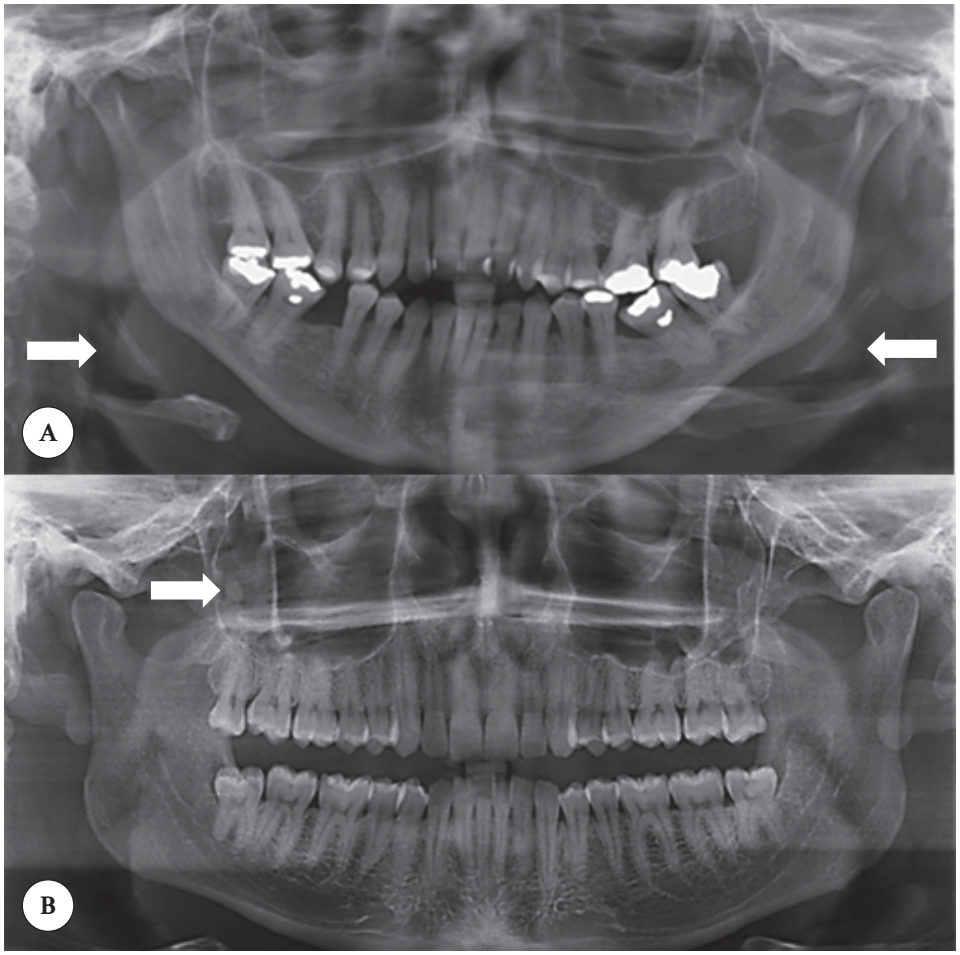

Figure 1. Panoramic radiography image with arrows suggesting the presence of (A) calcification of the stylohyoid ligament, and (B) anthrolith.

All data were tabulated using an Excel® spreadsheet and analyzed with SPSS®, version 23.0 (IBM® SPSS® Statistics v. 23.0, SPSS Inc, Chicago, IL, USA). Qualitative results were presented as absolute and relative frequencies, and quantitative as mean and standard deviation (SD). To assess potential associations between sex, age, and the presence or absence of calcifications, the Chi-square test was applied. A significance level of 5% ($p < 0.05$) was adopted.

RESULTS

A total of 384 exams from 226 women (58.90%) and 158 men (41.10%) were evaluated. The mean age of the sample was 38.2 years (SD ± 13.6), with a minimum of 18 and a maximum of 80. The mean age of those with calcification was 42.20 years (SD ± 14.10), while those without calcifications had a mean age of 37.60 years (SD ± 13.40).

Calcifications were found in 53 (13.80%) cases. Table 1 presents the frequencies per condition assessed, as well as the affected side.

Table 1. Distribution of calcifications in the head and neck region of adult patients treated at a radiology service at a university of Curitiba, PR, Brazil, between October 2018 and February 2020 (n = 384).

Calcification	Presence						Side			
	No		Not evaluated		Yes		Unilateral		Bilateral	
	n	%	n	%	n	%	n	%	n	%
Calcification of the stylohyoid ligament	226	58.80	134	35.00	24	6.20	-	-	24	100.00
Antrolith	90	23.40	284	74.20	10	2.40	5	50.00	5	50.00
Sialolith	349	90.80	29	7.60	6	1.60	5	83.30	1	16.70
Tonsilolith	350	91.10	28	7.30	6	1.60	5	83.30	1	16.70
Carotid artery calcification	362	94.30	18	4.70	4	1.00	4	100.00	-	
Calcification of triticeal cartilage	160	41.70	221	57.60	3	0.70	1	33.30	2	66.70

Among the alterations investigated, calcification of the stylohyoid ligament was most frequent (n = 24; 6.20%), followed by anthroliths (n = 10; 2.40%). Sialoliths and tonsilloliths had similar frequencies (n = 6; 1.60%). Calcified lymph nodes and phleboliths were not observed in this sample.

Table 2. Association between demographic variables and the presence of calcifications in the head and neck region of adult patients treated at a radiology service at a university of Curitiba, PR, Brazil, between October 2018 and February 2020 (n = 384).

Variable	Presence of calcification				p value*
	No/not evaluated (n = 331)		Yes (n = 53)		
	n	%	n	%	
Sex					
Female	192	58.00	34	64.20	0.399
Male	139	42.00	19	35.80	
Age (in years)					
18-27	97	29.30	9	15.10	
28-35	80	24.10	16	30.20	0.180
36-80	154	46.60	29	54.70	

*Chi-square test ($p < 0.05$).

No statistically significant associations (p > 0.05) were found between sex, age, and the presence of calcifications (Table 2). However, a higher frequency was noted among women (n = 34; 64.20%) and individuals aged 36 years or older (n = 29; 54.70%), as shown in table 3.

Table 3. Absolute frequency of calcifications in the head and neck region of adult patients treated at a radiology service at a university of Curitiba, PR, Brazil, between October 2018 and February 2020, according to sex and age (n = 384).

Variable	Calcification					
	Carotid artery calcification	**Sialolith**	**Tonsilolith**	**Antrolith**	**Calcification of triticeal cartilage**	**Calcification of the stylohyoid ligament**
Sex						
Male	2	4	2	2	0	9
Female	2	2	4	8	3	15
Age (in years)						
18-27	0	1	0	2	0	6
28-35	2	0	0	3	2	8
36-80	2	5	6	5	1	10

DISCUSSION

The aim of this study was to evaluate the prevalence of soft tissue calcifications in the head and neck region of adults using digital panoramic radiographs and to analyze the association with demographic factors.

The findings revealed a prevalence of calcified structures in 13.80% of cases, but no significant association with sex or age. Before making comparisons between the findings of other studies and those of the present one, it is important to highlight the peculiarities related to the sample size, location, and age range of the patients included in the studies. In addition to advancements in radiology equipment, such as sensors and ampoules, which now enable higher-quality images, the increased sensitivity and specificity of panoramic radiography (17), may have contributed to the rising prevalence estimates over time.

The study that most closely resembled the present, given the mean age and investigated alterations, was that of Ribeiro et al. (12). The authors examined patients from a Portuguese university and identified a prevalence of calcifications of 19.00%. Lower rates were observed by Darwin et al. (7), reaching 12.00%, but the authors did not clarify the location where the research was performed. In contrast, higher values were found by other authors. In an analysis of 9553 radiographic images of patients from a Dentistry school in Istanbul, a prevalence of 35.80% of calcifications in soft tissues in the head and neck region was identified (5). Also, Maia et al. (8) found a value of 43%, but the study was conducted with Brazilian elderly individuals over the age of 60.

Regarding the characterization of the sample by condition evaluated, calcification of the stylohyoid ligament was the most prevalent, aligning with previous studies (5, 12). Regarding bilaterality, the results found here corroborate those of Acikgoz and Akkemik (5).

Previous studies by Aoun and Nasseh (18) and Ribeiro et al. (12) reported even lower prevalence rates of 0.60% and 0.10%, respectively. These calcifications are believed to form due to chronic infections and mineral salt deposition in the affected region (19). Identifying anthroliths can be crucial in preventing complications associated with chronic sinusitis (18).

In the maxillary region, the presence of calcified masses in the region of the maxillary sinuses, characterized as anthroliths (18, 19), were observed in 2.40% of cases in this study. Anthroliths are a rare occurrence, with previous studies reporting absence (12) or prevalence rates as low as 0.10% (5, 18). This alteration has not

been identified in studies similar to the present research. Previous studies by Darwin et al. (7), Aoun and Nasseh (18), and Ribeiro et al. (12), reported prevalence rates of anthroliths, with values of 6.40%, 0.60%, and 0.10%, respectively. This calcification is believed to form due to episodes of chronic infection and mineral salt deposition in the affected region (19). Identifying anthroliths can be crucial in preventing complications associated with chronic sinusitis (18).

Among the radiopacities found in the jaw region, sialoliths were identified in 1.60% of cases, exceeding the prevalence rates reported by Sutter et al. (10) (0.90%) and Ribeiro et al. (12) (0.50%). Vengalath et al. (20) found sialoliths in 4.30% of the 1615 images evaluated, while Darwin et al. (7) reported 5.90%. In the present research, this calcification occurred unilaterally, as well as Sutter et al. (10).

Tonsilloliths were also found in 1.6% of the radiographs analyzed here. With an unclear etiopathogenesis, it is believed that chronic tonsillar inflammation may trigger the development of this calcification (21). In the literature, previous studies have reported varying prevalence rates, ranging from 0.90% (12) to 18.20% (22). Furthermore, studies have shown that unilateral tonsilloliths are more prevalent than bilateral ones (11), aligning with our findings. While tonsilloliths may not pose serious health risks, they can often cause unpleasant symptoms like dysphagia, bad taste, chronic halitosis, and upper airway obstruction (23).

In the posterior superior region of the mandible angle, between vertebrae C3 and C4, the presence of calcifications consistent with carotid artery calcification was also evaluated. Radiographically, this condition appears as a circular, homogeneous, or diffuse radiopaque structure (4). Of the images included in this research, only four cases (1.00%) exhibited this type of calcification. Additionally, the predominance of unilaterally suggestive images is consistent with Sutter et al. (10). While panoramic radiography is not the ideal method for diagnosing carotid artery calcifications, dentists must be able to differentiate these changes from others radiopacities in the region. Atheromas can increase the risk of cerebrovascular accidents, making their identification relevant, especially in hypertensive patients (4, 8).

The evaluation of radiopaque structures in the thyroid region consistent with calcification of the triticeal cartilage, occurred in 0.70% of cases. It is defined as a small ovoid cartilaginous structure, that extends from the hyoid bone to the thyroid cartilage and other laryngeal cartilages. It often undergoes calcification over time (24). Prevalence rates reported in the literature vary between 7.30% (6) and 12.00% (8).

Calcified lymph nodes and phleboliths were not observed in this study. Sutter et al. (10) reported a prevalence of 3.60% for calcified lymph nodes, with a unilateral predominance, while Vengalath et al. (20) found prevalence rate of 2.10%. Regarding phleboliths, which are areas of idiopathic calcification within thrombi, whether or not associated with hemangiomas and vascular malformations (25), have been reported to occur in 0.10% to 11.70% of cases (8, 20).

Regarding demographic variables, women exhibited a higher prevalence of calcifications compared to men, consistent with previous studies (4, 5, 7-10, 12, 18). However, this difference was not statistically significant, a result that corroborates the findings of Sutter et al. (10). Vengalath et al. (20) identified significant differences with women being more affected. In terms of age, in this research there was also no significant difference, similar to Sutter et al. (10) and Vengalath et al. (20). The mean age of individuals with calcifications was 42.2 years, suggesting an increased incidence from the fourth decade of life onwards (5, 8, 10, 12, 20).

While most calcifications investigated in this study are asymptomatic, epidemiological studies evaluating head and neck calcifications, often identified during routine dental examinations, remain valuable initial diagnostic tool. The findings underscore the importance of meticulous radiographic analysis to detect potential pathological calcifications in the soft tissues of the head and neck region. Moreover, the observation of these structures highlights the significant interface between Medicine and Dentistry.

As limitations of this study, the chosen design can be mentioned. Cross-sectional studies are generally unable to represent the diversity of the general population, as they are restricted to a specific group within a particular setting, which may directly influence the relevance and applicability of the findings to other populations. Additionally, such studies are more susceptible to selection bias because samples capture conditions at a single point in time, failing to account for variations over time or across different contexts. Consequently, cross-sectional designs lack the robustness to establish causal relationships in the same way that longitudinal studies do (26).

Another limitation concerns the chosen image analysis method: panoramic radiography. However,

it is a routine dental examination in dental offices and is widely used in research with similar objectives (4, 5, 8, 10, 12, 20). Therefore, this research did not intend to recommend panoramic radiography as a diagnostic tool to confirm the presence of different types of calcifications. The objective was to use this exam as an aid in identifying incidental findings that may indicate possible systemic changes in patients (6). It is known that, for example, the identification of carotid artery calcification is better with the use of ultrasound (14). Furthermore, the criteria adopted for the quality of the exams (15) included in the study may reveal another limitation, as the presented sample size represents, on average, one-third of the sample size in other studies (8, 10, 12).

It is suggested that studies with different designs and samples be conducted to better identify the calcifications discussed here and to clarify possible associations with demographic variables and various systemic conditions. It is worth noting that digital panoramic radiographs can serve as a tool for the initial diagnosis of systemic changes; therefore, there is clinical relevance in dentists actively searching for these changes.

CONCLUSIONS

The frequency of calcifications in the soft tissues of the head and neck region among the adults included in this research was high, with a particular emphasis on calcification of the stylohyoid process and anthroliths. Although there was no statistically significant association, women and individuals aged 36 years or older had a higher prevalence of the calcifications studied, regardless of type.

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