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DEPARTAMENTO DE CLÍNICA ODONTOLÓGICA
CURSO DE ODONTOLOGIA

JULIANA MARA OLIVEIRA SANTOS

**PREVALÊNCIA DE CALCIFICAÇÕES DA ARTÉRIA CARÓTIDA ENTRE 2,500
RADIOGRAFIAS PANORÂMICAS DIGITAIS DE UMA POPULAÇÃO ADULTA DO
NORDESTE BRASILEIRO**

FORTALEZA-CE

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Trabalho de Conclusão de Curso (TCC) apresentado à Universidade Federal do Ceará, Faculdade de Farmácia, Odontologia e Enfermagem, como requisito parcial para obtenção da graduação no curso de Odontologia.

Área de concentração: Radiologia.

Orientador: Prof. Dr. Fábio Wildson Gurgel Costa

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Aprovado em: ___/___/____.

BANCA EXAMINADORA

Prof. Dr. Fábio Wildson Gurgel Costa (Orientador)
Universidade Federal do Ceará (UFC)

Profa. Dra. Andréa Silvia Walter de Aguiar
Universidade Federal do Ceará (UFC)

Profa. Dra. Alynne Vieira de Menezes Pimenta
Universidade Federal do Ceará (UFC)

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APRESENTAÇÃO

Este trabalho de conclusão de curso (TCC) está de acordo com o formato alternativo para TCCs, que permite a inserção artigos científicos de autoria do candidato. Assim, este trabalho é composto de um artigo científico que será submetido ao periódico. As normas do referido periódico encontram-se em anexo.

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RESUMO

O presente trabalho objetivou realizar um estudo epidemiológico sobre o perfil demográfico de indivíduos com imagens sugestivas de calcificações da artéria carótida (CAC) em uma subpopulação do nordeste brasileiro. Foi realizado um estudo observacional, transversal, retrospectivo, com 2500 radiografias panorâmicas provenientes de um centro de referência imagiológica odontológica (Fortaleza, Ceará, Brasil). Foram incluídas imagens de indivíduos de ambos os sexos e com idade superior a 18 anos. Do total inicial, 96 (4%) apresentavam imagens sugestivas de CAC. Dessas, 40,4% das imagens sugestivas de CAC foram encontradas bilateralmente, 37,6% unilateralmente no lado direito e 22% unilateralmente no lado esquerdo. O sexo feminino ($p=0,003$) e as faixas etárias até 70 anos ($p=0,002$) foram de prevalência significativamente altas. Maioria significativa das radiografias exibiam CAC sugestivas no lado direito ($p<0,001$).

**PREVALENCE OF CAROTID ARTERY CALCIFICATIONS AMONG 2,500 DIGITAL
PANORAMIC RADIOGRAPHS OF AN ADULT NORTHEAST BRAZILIAN
POPULATION**

Abstract

Objectives: The aim of the present study was to analyze the epidemiological data of digital panoramic radiographs revealing suggestive images of carotid artery calcifications (CAC) from a Northeast Brazilian population.

Materials and methods: A cross-sectional retrospective study was conducted with 2,500 digital panoramic radiographs obtained from a single imaging reference center in Northeast Brazil. Images from individuals of both sexes and older than 18 years were included and those that did not cover the region of cervical vertebrae or presented low radiographic quality were excluded. Data were analyzed regarding prevalence, location (bilateral, right or left), sex, and age using the Chi-square test at the significance level of 5%.

Results: An amount of 96 (4%) patients presented suggestive images of CAC. The female sex ($p=0.003$) and individuals aged up to 70 years ($p=0.002$) were statically significant. 40.4% were found bilaterally, 37.6% on the right side ($p<0.001$) and 22% on the left side.

Conclusion: In conclusion, this study showed a low prevalence of suggestive images of CAC in digital panoramic radiographs from a Northeast Brazilian population. It was observed a higher prevalence of CAC associated with female sex, older patients, and right side location.

Key words: atherosclerosis; carotid artery; digital panoramic radiograph; prevalence.

Introduction

Coronary artery disease is considered a major cause of worldwide morbidity and mortality [1], being a multifactorial disorder in which multiple genetic variants are combined with several environmental risk factors and deleterious lifestyles [2]. It is characterized by the long-term formation of atheromatous plaques within the arterial walls, culminating in atherothrombotic obstructive lesions leading to local tissue damage, such as ischemic stroke, transient ischemic attack, or amaurosis fugax [3]. These aspects make the presence of atherosclerotic plaques a relevant health problem since heart attack is one of the main causes of death in the world, as well as it is closely related to severe impairments for the patients affected by this disease [4].

Carotid artery calcifications (CAC) can be visualized on panoramic radiographs, imaging exams that are routinely used in the evaluation of patients with dental issues [5]. The presence of CAC in these exams is an indicator of the risk of developing possible cardiovascular events, which justifies the clinical interest of the dentist in being able to identify these alterations early [6]. These alterations appear as single or multiple, non-continuous nodular radiopaque images, located on the intervertebral junction C3-C4, about 1 to 2.5 cm inferior to posterior to the angle of the mandible, or as vertical radiopaque lines representing thin vascular wall calcifications [7,8].

The differential diagnosis of atherosclerotic plaques includes anatomical structures of the neck region such as hyoid bone, trichoid cartilage, the superior horn of the calcified and epiglottic thyroid cartilage, and lesions such as sialoliths, elongation, and calcifications of the styloid process, calcifications in the stylomandibular and stylohyoid ligaments, phleboliths, among others [5,6,8].

Epidemiological studies have shown that the prevalence of CAC found in

panoramic radiographs, performed for dental reasons, is around 2% to 5% [9]. However, a limited number of studies regarding CAC prevalence on digital panoramic radiographs from South America have been published to date.

Clinical relevance: The present study aimed to evaluate the epidemiological data of digital panoramic radiographs showing suggestive images of CAC from a significant Northeast Brazilian population.

Materials and Methods

Study design

A retrospective cross-sectional study was performed with a sample of 2500 digital panoramic radiographs obtained between December 2011 to December 2014 from a private dental imaging clinic, which is a reference service in the state of Ceará, Brazil. The present study was approved by the Research Ethics Committee under protocol number 285/11. It was used the Cranex D (Soredex, Tuusula, Finland) digital panoramic and cephalometric imaging system. The images were acquired with Frankfurt's horizontal plane parallel to the ground and they were generated with a resolution of 300 dpi and setting parameters adjusted according to the patient's size.

Images of individuals under the age of 18 years, that did not cover the region of cervical vertebrae, or that presented low radiographic quality, were excluded from this sample (n=111). Two previously calibrated examiners (kappa coefficient = 0.856) analyzed the radiographs in order to detect images suggestive of CAC. The images were analyzed using Adobe Photoshop® CC 2015 software (Adobe Systems Incorporated, California, USA) for saturation and contrast in order to standardize images during data evaluation (Figure 1). CAC were considered present when it was observed heterogeneous radiopacities located into the intervertebral space between C3 and C4 [6]. Before the radiographic analysis, two examiners were calibrated in order to establish uniform criteria for imaging evaluation. Cohen's Kappa statistic was applied and it was obtained an inter-rater agreement value higher than 0.80. Doubts about the presence of CAC were interpreted by two oral and maxillofacial radiologists. The two radiologists analyzed 118 doubts of the panoramic radiographs being the main differential diagnosis the cricoid cartilage. The studied variables were sex, age, and location (bilateral, right unilateral or left unilateral).

Statistical analysis

The data were tabulated in Microsoft Excel 2010 software regarding location (bilateral, right unilateral or left unilateral), gender and age in order to obtain data on the prevalence of calcifications and the results were submitted to statistical treatment by the Chi-square test at the significance level of 5%. Statistical Package for the Social Sciences (SPSS) software 15.0 version for Windows (SPSS Inc.[®], Chicago, Illinois, USA) was used for all analysis.

Results

In this study, CAC prevalence was 4% (n=96) considering a sample with an estimated power of 99.6%. Table 1 showed a statically significant difference (p=0.003) between females (n=68; 70.8%) and males (n=28; 29.2%).

Radiographs suggesting CAC were observed in individuals with age ranging from 25 to 89 years (mean age of 54 ± 13 years). There was no statically significant difference (p=0.968) between male (54 ± 15 years) and female (54 ± 12 years) mean age. In addition, sex and age did not show a statically significant association with the right, left or both sides (p>0.05). The most prevalent and statically significant (p=0.002) age group was that one between 50 and 70 years (n=46; 47.9%), followed by individuals aged up to 50 years (n=38; 39.6%).

There was a statically significant amount of patients presenting suggestive images of CACs on the right side (p<0.001). However, there was no difference regarding the occurrence even in the left side (p=0.147) or in a bilateral presentation (p=0.110). According to Table 2, there was no statically significant association of sex with age groups (p=0.443), right side (p=0.635) or left side (p=0.379). Bilateral CAC did not show association with sex (p=0.198; Table 1) or age (p=0.598; Table 3).

Discussion

Atherosclerotic plaques in carotid arteries have been extensively studied in the field of Medicine and Dentistry. Indeed, atherosclerotic plaques have been considered important predictors of cardiovascular disorders and, therefore, their identification could be useful as a tool for medical stratification and health education strategies according to Gepner et al. [10]. In a systematic review with a meta-analysis published in 2017 by Gorgui et al. [3], the prevalence of atheromatous plaques differed according to geographic regions: South Africa (38.1%), United States (17.2-43%), Japan (29.8%), Europe (5.4%), Spain (60%), and China (44.4-51%).

In dentistry literature, Friedlander and Lander (1981) [7] were the first researchers to report CAC visualized on panoramic radiographs, emphasizing the importance of this exam since it is a routine radiograph required in dental practice and, in many cases, the identification of CAC is an accidental finding [5]. These aspects motivated the conduction of the present research, also reinforced by the retrospective collection of a substantial number of digital panoramic radiographs from a single reference center for maxillomandibular imaging exams in Northeast Brazil, which was higher than some previous studies (Table 4).

Almog et al. reported that the prevalence of CAC observed by panoramic radiographs has been usually described up to 5% with higher occurrence in patients with clinical conditions associated with atherosclerosis [9]. The present study showed a percentage of 4% in an adult Northeast Brazilian population and since it had a non-intentional sample recruitment, clinical data were not obtained, which may explain the different prevalence in comparison with other investigations (Table 4). Regarding epidemiological data on the worldwide prevalence of CAC in panoramic radiographs, there have been reported similar results to the present study in Germany, Saudi Arabia, and Japan [11-13]. A 10-year PubMed search for CAC in panoramic radiographs published since 2007 to 2016 (Table 4) rendered 22 studies (Asia, 50%; Europe,

18.2%; South America, 13.6%; North America, 9.1%; Africa, 9.1%), which showed a heterogeneous CAC prevalence ranging from 1.5 to 97%. In Brazil, the largest study that evaluated 8,338 panoramic radiographs was performed in the South region and it showed a CAC prevalence of 6.9% [14]. Thus, the present study is the second one in Brazil that presented a significant sample size and it is the largest one from the Brazilian Northeast region to the present date.

In the present cross-sectional study, the age group between 50 and 70 years showed a statistical significance prevalence. A similar result was observed by Lee et al. (2013) [13] since the authors found a higher prevalence of images suggestive of atheromatous plaques in patients aged 40 to 70 years. These results reinforce the age as an important risk factor for CAC. In younger patients, only a small number of cases of carotid artery calcifications has been found. In spite of this finding, atheromatous plaques should be suspected at any age, justifying the evaluation of panoramic radiographs in younger patients [15].

This study showed a statistically significant prevalence of CAC in women, which has been commonly found in the literature. Friedlander and Altman (1981) [7] stated that this association may occur due to a decline in the estrogen level after menopause. Since it is a hormone that acts on lipoproteins metabolism by preventing the formation of atheromatous plaques, its reduced level may precipitate the formation of atheromas. Friedlander et al. (2001) [16] evaluated the panoramic radiographs of women with a history of amenorrhea greater than 12 months and images suggestive of CAC appeared in 31% of the radiographs. Patil et al. (2015) [17] reported a 22.9% prevalence of CAC in women aged over 50 years among a sample of 1,214 panoramic radiographs. Regarding occurrence of CAC in men, it has been considered that the smoking habit plays an important risk factor for its development, which differs in relation to women as described by Cohen et al. [18].

The right side showed a statistically significant prevalence in the present study. Similar findings were found by Ohba et al. (2003) [19], which revealed a prevalence of 74% of CAC on the right side. This result is reasonable according to aforementioned authors, which cited that the level of bifurcation of the right carotid artery is most often located between C3 and C4, whereas the left carotid artery shows a bifurcation mostly observed between C4 and C5.

In the present investigation, the differential diagnosis included radiopaque structures resembling atheromatous plaques on digital panoramic radiographs. CAC were considered in the presence of one or more non-continuous adjacent radiopaque nodular images or vertical lines at the intervertebral space between C3 and C4, and located posteriorly and lower than the mandibular angle [20,21]. In addition, the present study included as potential differential diagnosis other conditions, including sialoliths, tonsilloliths, as well as stylohyoid ligament and triticeous cartilage calcifications, and the hyoid bone. Sialoliths are usually located in the submandibular gland or in its duct and have a radiographic pattern as a single or multiple calcifications. On panoramic radiographs, they can be seen superimposed on or below the body or ramus of the mandible, which is a most anterior location than observed in CAC. Tonsilloliths are small calcifications developed into tonsillar crypts and are described as radiopaque images superimposed on the mandibular branch on panoramic radiographs. The styloid process has been radiographically described as a cylindrical and radiopaque image projecting forward and down between the mandible ramus and the mastoid process. The hyoid bone is presented as a bilateral and horizontal well-defined radiopaque image located below the mandible. Calcified triticeous cartilage presents as an ovoid radiopaque image, about 2 to 4 mm wide and 7 to 9 mm long, normally found within the air space adjacent to the pharynx [21].

Regarding the study design adopted in this research, it was not possible to use the Doppler ultrasonography in order to confirm the diagnosis of CAC. However, in the field of

Oral and Maxillofacial Radiology, we believe that is important to add literature concerning epidemiological data from different geographic locations.

Conclusion

In summary, the present study showed a low prevalence of suggestive images of CACs on digital panoramic radiographs from an adult South American subpopulation. It was observed a higher prevalence in women and older patients, and the right side was the main location for CAC.

Disclosure statement

All authors state that they have no conflicts of interest.

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References

- [1] Sulo E, Nygård O, Vollset SE, Igland J, Ebbing M, Østbye T, Jørgensen T, Sulo G, Tell GS. Time Trends and Educational Inequalities in Out-of-Hospital Coronary Deaths in Norway 1995-2009: A Cardiovascular Disease in Norway (CVDNOR) Project. *J Am Heart Assoc.* 2017; 6:e005236.
- [2] Fawzy MS, Toraih EA, Aly NM, Fakh-Eldeen A, Badran DI, Hussein MH. Atherosclerotic and thrombotic genetic and environmental determinants in Egyptian coronary artery disease patients: a pilot study. *BMC Cardiovasc Disord.* 2017; 17:26.
- [3] Gorgui J, Gasbarrino K, Georgakis MK, Karalexi MA, Nauche B, Petridou ET, Daskalopoulou SS. Circulating adiponectin levels in relation to carotid atherosclerotic plaque presence, ischemic stroke risk, and mortality: A systematic review and meta-analyses. *Metabolism.* 2017; 69:51-66.
- [4] Olindo S, Saint-Vil M, Jeannin S, Signate A, Edimonana-Kaptue M, Cabre P, Chausson N, Smadja D, Joux J. One-year disability, death and recurrence after first-ever stroke in a Black Afro-Caribbean population. *Int J Stroke.* 2016; 1:1747493016685720.
- [5] Friedlander, AH, Garret, NR, Norman, DC. The prevalence of calcified carotid artery atheromas on the panoramic radiographs of patients with type 2 diabetes mellitus. *J Am Dent*

Assoc. 2002; 133:1516-1523.

[6] Friedlander, AH; Gratt, BM. Panoramic dental radiography as an aid in detecting patients at risk for stroke. *J Oral Maxillofac Surg.* 1994; 52:1257-1262.

[7] Friedlander AH, Lande A. Panoramic x-ray identification of carotid arterial plaques. *J Am Dent Assoc.* 1981; 52:102- 104.

[8] Friedlander, AH, Manesh, F, Wasterlain, C. Prevalence of detectable carotid artery calcification on panoramic radiographs of recent stroke victims. *J Am Dent Assoc.* 1994; 77:669-673.

[9] Almog DM, Horev T, Illig KA, Green RM, Carter LC. Correlating carotid artery stenosis detected by panoramic radiography with clinically relevant carotid artery stenosis determined by duplex ultrasound. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2002; 94:768-773.

[10] Gepner AD, Young R, Delaney JA, Budoff MJ, Polak JF, Blaha MJ, Post WS, Michos ED, Kaufman J, Stein JH. Comparison of Carotid Plaque Score and Coronary Artery Calcium Score for Predicting Cardiovascular Disease Events: The Multi-Ethnic Study of Atherosclerosis. *J Am Heart Assoc.* 2017; 6:e005179.

[11] Tiller R, Bengel W, Rinke S, Ziebolz D. Association between carotid area calcifications and periodontal risk: a cross sectional study of panoramic radiographic findings. *BMC Cardiovasc Disord.* 2011; 11:67.

[12] Alzoman HA, Ra'ed I, Al-Lahem Z. H, Al-Sakaker AN, Al-Fawaz Y F. Prevalence of carotid calcification detected on panoramic radiographs in a Saudi population from a training institute in Central Saudi Arabia. *Saudi Med J.* 2012; 33:177-181.

[13] Lee JS, Kim OS, Chung HJ, Kim YJ, Kweon SS, Lee YH, Shin MH, Yoon SJ. The prevalence and correlation of carotid artery calcification on panoramic radiographs and peripheral arterial disease in a population from the Republic of Korea: the Dong-gu study. *Dentomaxillofac Radiol.* 2013; 42:29725099.

[14] Gonçalves JR, Yamada JL, Berrocal C, Westphalen FH, Franco A, Fernandes Â. Prevalence of Pathologic Findings in Panoramic Radiographs: Calcified Carotid Artery Atheroma. *Acta Stomatol Croat.* 2016; 50:230-234.

[15] Bayer S, Helfgen EH, Bös C, Kraus D, Enkling N, Mues S. Prevalence of findings compatible with carotid artery calcifications on dental panoramic radiographs. *Clin Oral Invest.* 2011; 15:563-569.

[16] Friedlander AH, Altman L. Carotid artery atheromas in postmenopausal women: their

prevalence on panoramic radiographs and their relationship to atherogenic risk factors. *J Am Dent Assoc.* 2001; 132:1130-1136.

[17] Patil SR. Prevalence of carotid artery calcification in postmenopausal women and its correlation with atherogenic risk factors. *J Nat Sci Biol Med.* 2015; 6:1.

[18] Cohen SN, Friedlander AH, Jolly DA, Date L. Carotid calcification on panoramic radiographs: an important marker for vascular risk. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2002; 94:510-514.

[19]. Ohba T, Takata Y, Ansai T, Morimoto Y, Tanaka T, Kito S, Takehara T. Evaluation of calcified carotid artery atheromas detected by panoramic radiograph among 80-year-olds. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2003; 96:647-650.

[20] Lewis DA, Brooks SL. Carotid artery calcification in a general dental population: a retrospective study of panoramic radiographs. *Gen Dent.* 1999; 47:98-103.

[21] Friedlander AH, Friedlander IK. Identification of stroke prone patients by panoramic radiography. *Aust Dent J.* 1998; 43:51-54.

[22] Gokce C, Sisman Y, Sipahioglu M, Ertas ET, Akgunlu F, Unal A, Utas C. The prevalence of carotid artery calcification on the panoramic radiographs of end-stage renal disease patients

with peritoneal dialysis: do incidental findings provide life-saving information?. *J Int Med Res.* 2008; 36:47-53.

[23] Damaskos S, Griniatsos J, Tsekouras N, Georgopoulos S, Klonaris C, Bastounis E, Tsiklakis K, Spyros et al. Reliability of panoramic radiograph for carotid atheroma detection: a study in patients who fulfill the criteria for carotid endarterectomy. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2008; 106:736-742.

[24] Yoon SJ, Yoon W, Kim OS, Lee JS, Kang BC. Diagnostic accuracy of panoramic radiography in the detection of calcified carotid artery. *Dentomaxillofac Radiol.* 2008; 37:104-107.

[25] Kansu O, Ozbek M, Avcu N, Aslan U, Kansu H, Gençtoy G. Can dental pulp calcification serve as a diagnostic marker for carotid artery calcification in patients with renal diseases?. *Dentomaxillofac Radiol.* 2009; 38:542-545.

[26] Khosropanah SH, Shahidi SH, Bronoosh P, Rasekhi A. Evaluation of carotid calcification detected using panoramic radiography and carotid Doppler sonography in patients with and without coronary artery disease. *Br Dent J.* 2009; 207:e8.

[27] Pornprasertsuk-Damrongsri S, Virayavanich W, Thanakun S, Siritwongpairat P, Amaekchok P, Khovidhunkit W. The prevalence of carotid artery calcifications detected on panoramic radiographs in patients with metabolic syndrome. *Oral Surg Oral Med Oral Pathol*

Oral Radiol Endod. 2009; 108:e57-e62.

[28] Taheri JB, Moshfeghi M. Prevalence of calcified carotid artery on panoramic radiographs in postmenopausal women. *J Dent Res Dent Clin Dent Prospects*. 2009; 3:46-51.

[29] Horsley SH, Beckstrom B, Clark SJ, Scheetz JP, Khan Z, Farman AG. Prevalence of carotid and pulp calcifications: a correlation using digital panoramic radiographs. *Int J Comput Assist Radiol Surg*. 2009; 4:169-173.

[30] Christou P, Leemann B, Schimmel M, Kiliaridis S, Müller F. Carotid artery calcification in ischemic stroke patients detected in standard dental panoramic radiographs—a preliminary study. *Adv Med Sci*. 2010; 55:26-31.

[31] Johansson EP, Ahlqvist J, Garoff M, Karp K, Jäghagen EL, Wester P. Ultrasound screening for asymptomatic carotid stenosis in subjects with calcification in the area of the carotid arteries on panoramic radiographs: a cross-sectional study. *BMC Cardiovasc Disord*. 2011; 11:1-9.

[32] Khambete N, Kumar R, Risbud M, Joshi A. Evaluation of carotid artery atheromatous plaques using digital panoramic radiographs with Doppler sonography as the ground truth. *J Oral Biol Craniofac Res*. 2012; 2:149-153.

[33] Imanimoghaddam M, Rooh MR, Hashemi EM, Blouri AJ. Doppler sonography confirmation in patients showing calcified carotid artery atheroma in panoramic radiography and evaluation of related risk factors. *J Dent Res Dent Clin Dent Prospects*. 2012; 6:6.

[34] Patil S, Sinha N. Pulp stone, haemodialysis, end-stage renal disease, carotid atherosclerosis. *J Clin Diagn Res*. 2013; 7:1228.

[35] Alman AC, Johnson LR, Calverley DC, Grunwald GK, Lezotte DC, Hokanson JE. Validation of a method for quantifying carotid artery calcification from panoramic radiographs. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2013;116:518-524.

[36] Garay I, Netto HD, Olate S. Soft tissue calcified in mandibular angle area observed by means of panoramic radiography. *Int J Clin Exp Med*. 2014; 7:51.

[37] Kamak G, Yildiri E, Rencber E. Evaluation of the relationship between periodontal risk and carotid artery calcifications on panoramic radiographs. *Eur J Dent*. 2015; 9:483.

[38] Brito ACRD, Nascimento, HAR, Argento R, Beline T, Ambrosano GMB, Freitas DQ. Prevalence of suggestive images of carotid artery calcifications on panoramic radiographs and its relationship with predisposing factors. *Cien Saude Colet*. 2016; 21:2201-2208.

ANEXOS

Table 1: Characterization of the sample according to sex, age and location.

	n	%	p-Value
Sex			
Female	68*	70.8	0.003
Male	28	29.2	
Age (years)			
Up to 50	38*	39.6	0.002
51-70	46*	47.9	
> 70	12	12.5	
Right side			
No	21	21.9	<0.001
Yes	75*	78.1	
Left side			
No	38	39.6	0.147
Yes	58	60.4	
Laterality			
Unilateral	59	61.5	0.110
Bilateral	37	38.5	

*p<0.05, chi-square test. Data expressed as absolute and percentage frequency.

Table 2: Characterization of sex according to age, side and laterality.

	Sex		p-Value
	Female (%)	Male (%)	
Age (years)			
Up to 50	26 (38.2%)	12 (42.9%)	0.443
51-70	35 (51.5%)	11 (39.3%)	
> 70	7 (10.3%)	5 (17.9%)	
Right side			
No	14 (20.6%)	7 (25%)	0.635
Yes	54 (79.4%)	21 (75%)	
Left side			
No	25 (36.8%)	13 (46.4%)	0.379
Yes	43 (63.2%)	15 (53.6%)	
Laterality			
Unilateral	39 (57.4%)	20 (71.4%)	0.198
Bilateral	29 (42.6%)	8 (28.6%)	

*p<0.05, chi-square test. Data expressed as absolute and percentage frequency.

Table 3: Characterization of the sample according to age versus sex, side and laterality.

	Age (years)			p-Value
	Up to 50	51-70	> 70	
Sex				
Female	26 68.4%	35 76.1%	7 58.3%	0.443
Male	12 31.6%	11 23.9%	5 41.7%	
Right side				
No	7 18.4%	13 28.3%	1 8.3%	0.266
Yes	31 81.6%	33 71.7%	11 91.7%	
Left side				
No	14 36.8%	17 37.0%	7 58.3%	0.365
Yes	24 63.2%	29 63.0%	5 41.7%	
Laterality				
Unilateral	21 55.3%	30 65.2%	8 66.7%	0.598
Bilateral	17 44.7%	16 34.8%	4 33.3%	

*p<0.05, chi-square test. Data expressed as absolute and percentage frequency.

Table 4: Literature review based on the research for the terms “panoramic” and “carotid artery calcification” from the last 10 years.

Authors	Country	Number of patients	Considerations
Gokce et al. (2007) [22]	Turkey	750	The CAC in the present study were detected by panoramic radiographs in 27.4% of end-stage renal disease patients being treated with peritoneal dialysis.
Damaskos et al. (2008) [23]	Greece	40	100% positive predictive value per patient and for luminal stenosis >80%, indicates that positive calcification panoramic radiographs findings at the C3-C4 region are highly suggestive for carotid artery atherosclerotic occlusive disease.
Yoon et al. (2008) [24]	South Korea	110	Panoramic radiography has a moderate diagnostic accuracy in the detection of CAC, but the sensitivity is low.
Kansu et al. (2009) [25]	Turkey	60 nephrology patients	CAC were detected in 11 patients (6 haemodialysis patients and 5 transplant recipients).
Khosropanah et al. (2009) [26]	Iran	84	The panoramic radiograph had a sensitivity of 66.6% and a positive predictive value of 45% for detecting CAC in patients whose angiograms confirmed the coronary artery disease.
Pornprasertsuk et al. (2009) [27]	Thailand	85	CAC were detected in 19 subjects (22.4%) in patients with metabolic syndrome

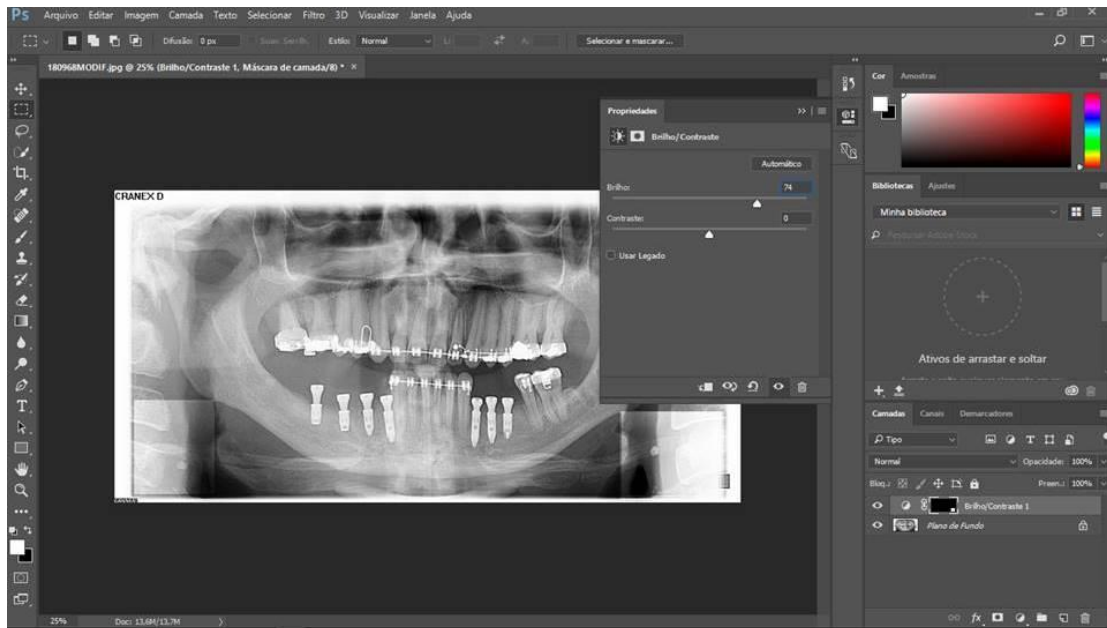
Taheri et al. (2009) [28]	Iran	200 of postmenopausal women	Prevalence of CAC is 11.0 % in 50 year-old and older postmenopausal dental outpatients.
Horsley et al. (2009) [29]	USA	247	32% had pulpal calcifications and 25% had CAC with 12% having both carotid and pulp calcifications.
Christou et al. (2010) [30]	Switzerland	14 patients with recent ischemic stroke and stenosis of the carotid artery confirmed by Duplex sonography	From 21 carotid artery calcifications detected with Doppler sonography 15 were visible on the corresponding panoramic radiographs.
Johansson et al. (2011) [31]	Sweden	1182	CAC were seen in 14,8% persons undergoing panoramic radiography.
Khambete et al. (2012) [32]	India	50	Digital panoramic radiographs had sensitivity of 76% and specificity of 98.66% in determining calcified carotid artery atheromatous plaques.
Imanimoghaddam et al. (2012) [33]	Iran	960	Fifteen patients (30 sides) showed calcification in their panoramic radiographs, and underwent doppler sonography which

			revealed CAC in 16 sides (12 patients)
Lee et al. (2013) [13]	South Korea	4078	The prevalence of CAC on panoramic radiographs was 6.2%
Patil et al. (2013) [34]	India	112 End-Stage Renal Disease patients	CAC were detected in none of the patients.
Alman et al. (2013) [35]	USA	122	The area of CAC from panoramic radiographs is well correlated with stenosis and the common carotid artery resistive index from Doppler ultrasonography.
Garay et al. (2014) [36]	Chile	3028	29% of the 79 calcifications found were CAC
Kamak et al. (2015) [37]	Turkey	1146	CAC was diagnosed in 13,6% of the panoramic radiographs.
Patil (2015) [17]	Saudi Arabia	1214 panoramic radiographs of postmenopausal females	Prevalence of CAC was 22.9%
Gonçalves et al. (2016) [14]	Brazil	8.338	Images suggestive of calcified carotid artery atheromas was found in 6,9% of the patients.

Brito et al. (2016) [38]	Brazil	505	The results showed a 7.92% prevalence of suggestive images of calcifications
Present study	Brazil	2500	Prevalence of 4%.

Figure 1: Adobe Photoshop window showing the use of a filter with saturation and balance

standardized in order to analysis a bilateral CAC on panoramic radiograph.



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