Journal of Dentistry Indonesia

Volume 26
Number 1 *April*

Article 1

4-30-2019

Structures Suggestive of Carotid Artery Calcifications and Their Prevalence on Digital Panoramic Radiographs

Luana P.V. Adad
Department of Stomatology, Federal University of Paraná, Curitiba, Brazil

Lucas B. Oliveira
Department of Stomatology, Federal University of Paraná, Curitiba, Brazil

Sther G. Orestes
Department of Stomatology, Federal University of Paraná, Curitiba, Brazil

Flávia Vetter
Department of Stomatology, Federal University of Paraná, Curitiba, Brazil

Ademir Franco
Department of Stomatology, Federal University of Paraná, Curitiba, Brazil; Department of Therapeutic Stomatology, Institute of Dentistry, I.M. Sechenov First Moscow State Medical University, Moscow, Russia

See next page for additional authors

Recommended Citation

Adad, L. P., Oliveira, L. B., Orestes, S. G., Vetter, F., Franco, A., Makeeva, I., & Fernandes, Â. Structures Suggestive of Carotid Artery Calcifications and Their Prevalence on Digital Panoramic Radiographs. J Dent Indones. 2019;26(1): 1-4

Structures Suggestive of Carotid Artery Calcifications and Their Prevalence on Digital Panoramic Radiographs

Authors

Luana P.V. Adad, Lucas B. Oliveira, Sther G. Orestes, Flávia Vetter, Ademir Franco, Irina Makeeva, and Ângela Fernandes

Journal of Dentistry Indonesia 2019, Vol. 26, No. 1, 1-4
doi: 10.14693/jdi.v26i1.1234

ORIGINAL ARTICLE

Structures Suggestive of Carotid Artery Calcifications and Their Prevalence on Digital Panoramic Radiographs

Luana P.V. Adad[1], Lucas B. Oliveira[1], Sther G. Orestes[1], Flávia Vetter[1], Ademir Franco[1,2], Irina Makeeva[1], Ângela Fernandes[1]

[1]Department of Stomatology, Federal University of Paraná, Curitiba, Brazil
[2]Department of Therapeutic Stomatology, Institute of Dentistry, I.M. Sechenov First Moscow State Medical University, Moscow, Russia
Corresponding e-mail to: angelfnandes@hotmail.com

ABSTRACT

Objectives: To investigate prevalence of carotid artery calcifications via digital panoramic radiographs of patients who underwent dental treatment. **Methods:** Panoramic radiographs of 12.687 patients who underwent dental treatment at a federal university, were collected (male, n = 5.169, 40.7%; female, n = 7.518, 59.3%). Patients were aged 2–87 years (mean age, 34 years). Radiographs were obtained using a digital device. Two trained examiners analyzed the images with an imaging software package. Radiopaque images in the C3 and C4 cervical vertebrae region were searched for. Statistical outcomes were analyzed based on their association with sex and age. **Results:** The prevalence rate of carotid artery calcifications was 1.8% (n = 227). We identified unilateral (n = 140, 61.67%) and bilateral (n = 87, 38.33%) calcifications. Prevalence and sex (130 females, 97 males) were not statistically significant ($p > 0.05$). We observed calcifications predominantly in patients aged 50–60 years ($p < 0.05$). **Conclusion**: Awareness by physicians and dentists of the possible presence of carotid artery calcifications on digital panoramic radiographs is necessary. To optimize the risk management of vascular diseases, asymptomatic patients in their fifties or sixties must receive additional attention because panoramic radiographs may lead to diagnosis.

Key words: cervical vertebrae, dentistry, medicine, vascular calcification

How to cite this article: Luana P.V. Adad, Lucas B. Oliveira, Sther G. Orestes, Flávia Vetter, Ademir Franco, Irina Makeeva, Ângela Fernandes. Structures Suggestive of Carotid Artery Calcifications and Their Prevalance on Digital Panoramic Radiopgraphs.J Dent Indones. 2019;26(1):1-4

INTRODUCTION

In dentistry, panoramic radiographs are commonly used for treatment planning and follow-up. They provide an overview of the maxillofacial bones and teeth. Therefore, most dentists perform surgical and orthopedic procedures with the aid of panoramic radiographs. However, few professionals are aware of the potential use of these radiographs to examine anatomical structures in the neck. Specifically, it has been shown that carotid artery calcifications (CACs) may be detected using panoramic radiographs in asymptomatic patients during a dental treatment.[1]

Radiographically, CACs appear as uni- or bilateral radiopaque images adjacent to the cervical vertebrae C3 and C4.[2] Biologically, CACs develop as a consequence of the accumulation and deposition of fats in the lumen of the artery. Subsequently, inflammation is triggered. This leads to fibroblast proliferation, calcium incrustation, and dystrophic calcification.[3] CAC gradually evolves. At first, patients may remain asymptomatic. However, it is well documented that they subsequently develop atherosclerosis and noncardiogenic strokes.[4] Atherosclerosis and noncardiogenic strokes may have important consequences, which can directly impact patients' quality of life.

The importance and justification of this study rely on the potential use of panoramic radiographs to detect and identify radiographic images suggestive of CAC in asymptomatic patients undergoing dental treatment. Based on the exposed background, in this study, we considered the hypothesis that elderly patients present with a high prevalence of CAC on panoramic radiographs. As a consequence, we aimed at investigating CAC's prevalence on digital panoramic

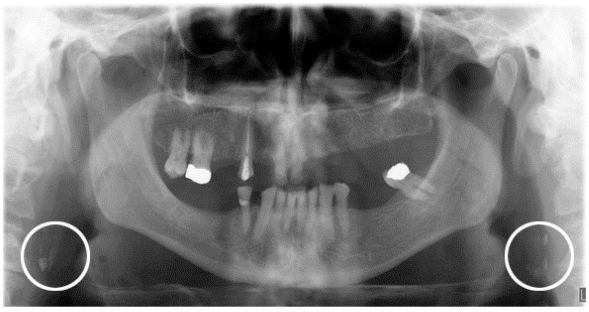

Figure 1. Radiopaque images adjacent to the cervical vertebrae (circles) suggestive of carotid artery calcifications.

radiographs of patients who underwent dental treatment at a medical reference facility. Additionally, we aimed at screening the profiles of patients at a higher risk for stroke based on the prevalence of CAC.

METHODS

The current study was performed after obtaining ethical clearance from the local committee of ethics in human research (protocol #980.997). In total, 12.687 panoramic radiographs were collected from male (n = 5.169, 40.7%) and female (n = 7.518, 59.3%) Brazilian patients. The patients were aged 2–87 years (mean age, 35 years) and underwent dental treatment at a medical reference center in South Brazil between 2015 and 2017. For radiography, we used the Orthopantomograph OP200D (Instrumentarium Dental, Tuusula, Finland) digital device.

The inclusion criteria were as follows: availability of eligible patients' records (including sex and age information) and radiography performed between 2015 and 2017. Exclusion criteria were as follows: radiographs of a low quality and those lacking a clear view of the cervical region.

Two trained dental students experienced in oral and maxillofacial imaging analyzed all the radiographs. Evaluation was done in a dark room, using a personal computer with a 14" LCD screen. Adobe Photoshop CS5 software (Adobe Systems, San Diego, CA, USA) was employed for image magnification and contrast manipulation. During the analysis, examiners searched for and registered radiopaque structures in the soft tissues adjacent to the cervical vertebrae C3 and C4 (Figure 1).

Occurrence of CAC was associated with patients' sex and age, as revealed by the results of the Chi-square test. Specifically, to investigate the association with age, patients were subdivided into groups with 10-year age intervals. Statistical analyses were performed using the SPSS software package (IBM Corp., Armonk, NY, USA). Significance level was set at 5%.

Table 1. Absolute (n) and relative (%) values of the prevalence of carotid artery calcifications (CAC) in digital panoramic radiographs based on the side of occurrence.

Side	N (%)
Right	66 (29.07)
Left	74 (32.60)
Bilateral	87 (38.33)
Total	227 (100)

Table 2. Absolute (n) and relative (%) values of the prevalence of carotid artery calcifications (CAC) in digital panoramic radiographs based on sex.

Sex	N(%)	p
Female	7,518 (59.25)	>0.05
Male	5,169 (40.75)	
Total	12,687 (100)	

p: significance level 5%

As summarized in table 3, the majority of patients with CAC were aged 51–70 years ($p < 0.05$).

Table 3. Absolute (n) values of the prevalence of carotid artery calcifications (CAC) on digital panoramic radiographs based on their occurrence in specific age groups.

Age (years)	CAC			
	Present (n)	Absent (n)	Total	p
2–10	0	924	924	<0.05
11–20	2	2015	2017	
21–30	9	3249	3258	
31–40	17	2122	2139	
41–50	28	1766	1794	
51–60	73	1445	1518	
61–70	58	702	760	
>70	40	236	237	
TOTAL	227	12459	12686	

p: significance level 5%

RESULTS

CAC was observed on a total of 227 radiographs (1.8%). As shown in Table 1, location of findings was both unilateral (n = 140, 61.67%) and bilateral (n = 87, 38.33%).

CACs were more frequently observed in females. However, as shown in Table 2, the association of CAC occurrence with sex was not statistically significant ($p > 0.05$).

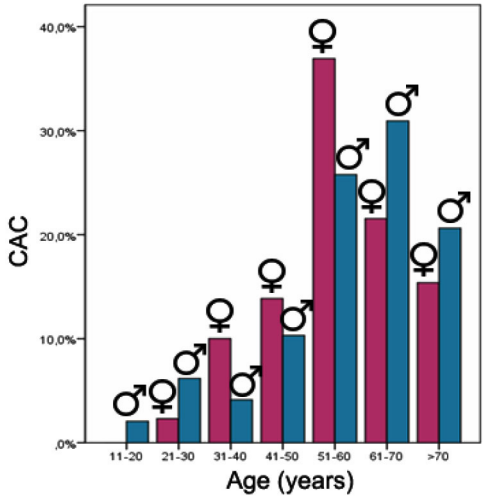

Figure 2. Distribution of images suggestive of of carotid artery calcification (CAC) based on sex and age.

As shown in Figure 2, CAC appeared to have a higher prevalence in females aged 51–60 years and in males aged 61–70 years ($p < 0.05$).

DISCUSSION

CACs can be identified in asymptomatic patients via analysis of radiographic findings. Specifically, radiopaque structures may be observed on panoramic radiographs, particularly in patients undergoing dental treatment. Dentists and physicians must be familiar with the possible occurrence of this finding as well as its prevalence. Of note, such information would allow to support the patient at an appropriate time for medical interventions. In the current study, we screened a large database of digital panoramic radiographs with the goal of identifying images suggestive of CAC.

We observed a 1.8% prevalence rate of CAC. To the best of our knowledge, previous studies do not define the exact prevalence of this finding. Earlier reports have shown that the prevalence rates vary depending on the sample size and population. Specifically, Barona-Dorado *et al*.[5] (2016) reported a prevalence of 15.4% based on 1.130 radiographs. The authors exclusively sampled Spanish patients aged >18 years. High CAC prevalence rates (26%) were also observed by Khambete and Kumar[6] (2015). However, authors in the latter study exclusively sampled type II diabetes mellitus patients, and high rates of CAC were expected because diabetes mellitus is a risk factor for atheroma. Interestingly, in the control group (including patients without diabetes mellitus), the authors observed a 6% prevalence of CAC. In a recent study, Patil[7] (2015) investigated the potential risk factors associate with the postmenopausal period in the occurrence of atheroma. In total, 1.214 radiographs were analyzed. Women's ages were between 50 and 60 years in 617 cases and ≥61 years in 597. The authors observed CAC in 22.9% of the patients. This study differs from both studies mainly in the sample size (n = 12.687). Specifically, our sample size is considerably larger than those reported in previous studies. Furthermore, sampled subjects were not selected based on medical history. We applied no restriction on the inclusion and exclusion criteria. Such differences corroborate the hypothesis founded on the influence of sampling over the outcomes.

Here we made statistical inferences on the associations among sex, age, and prevalence with respect to CAC. We did not observe a statistically significant association based on sex ($p > 0.05$). However, a statistically significant association was observed between age and prevalence of CAC ($p < 0.05$). Recently, Brito *et al*.[8] (2016) detected CAC in 7.92% of the 505 panoramic radiographs analyzed. The authors found a higher prevalence of CAC in females (8.82%) than in males. In line with these results, in the present study, we observed CAC in a higher number of females. However, the prevalence rate was considerably lower (1.02%). Of note, the sample distribution was heterogeneous. Consequently, the outcomes may have been influenced by differences between the number of females and males. However, no statistical significance was observed for the outcomes based on the association with sex. In accordance to the current study, Brito *et al*.[8] (2016) also observed a higher prevalence of CAC in elder individuals (19.85% of patients were aged 61–80 years). Similarly, in this study, most CAC patients were aged >50 years (mean age, 58 years). As previously explained, calcifications within blood vessels occur progressively. Specifically, they are the consequence of a biological process following an injury (inflammation from fat deposits). Thus, adults and the elderly are higher susceptible to CAC occurrence. Such a condition may worsen in presence of risk factors for vascular diseases[9] (e.g., smoking).[10] In an earlier study by Kumagai *et al*.[10], the authors confirmed this statement by reporting that in nonsmokers, the prevalence of CAC is approximately 4%, whereas in smokers, it reaches 14%.

Although the scientific literature unanimously shows that CAC is detected by panoramic radiographs, to date, studies with large sample sets remain scarce.[1] This study is innovative because the sample set analyzed was considerably larger than that analyzed in previous studies. Conversely, broad sampling can only be performed when few (or no) sample stratifications are applied (e.g., by selecting patients with specific habits and diseases, such as smoking and diabetes mellitus, respectively). We believe that additional studies are needed to reach a higher level of scientific evidence for the use of panoramic radiographs to detect CAC. To this end, systematic reviews and meta-analyses represent powerful scientific tools.

CONCLUSION

Panoramic radiographs represent a clinical imaging tool which can provide an overview of radiopaque structures suggestive of CAC. Dentists play an important role in this context, particularly for the detection of vascular diseases in asymptomatic patients. This is especially true in adults and elderly individuals. We believe that panoramic radiographs represent the first step toward a deeper medical investigation. Following the initial diagnosis, patients with radiographic images suggestive of CAC need to be examined with more advanced and accurate imaging tools and must be followed up by specialized physicians for treatment.

ACKNOWLEDGMENT

The authors express their gratitude to all the staff members of the Laboratory of Imaging of the Federal University of Paraná for supporting the present research with technical efforts and time.

CONFLICT OF INTEREST

The authors involved in this research declare no conflict of interest.

REFERENCES

1. 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(1):510-4.
2. Gonçalves JRSN, Yamada JLY, Berrocal C, Westphalen FH, Franco A, Fernandes A. Prevalence of pathologic findings in panoramic radiographs: calcified carotid artery atheroma. Acta Stomatol Croat. 2016; 50(3):230-4.
3. De Moraes MEL, De Moraes MB, Moraes LCD, Castilho JCM, Médici Filho E. Evaluation of carotid artery atheroma by panoramic radiography. Rev Odonto. 2009; 17(33):110-4.
4. Friedlander AH, Freymiller EG. Detection of radiation-accelerated atherosclerosis of the carotid artery by panoramic radiography. A new opportunity for dentists. J Am Dent Assoc. 2003; 134(10):1361-5.
5. Barona-Dorado C, Gutierrez-Bonet C, Leco-Berrocal I, Fernandéz-Cáliz F, Martínez-González JM. Relation between diagnosis of atheromatous plaque from orthopantomographs and cardiovascular risk factors. A study of cases and control subjects. Med Oral Patol Oral Cir Bucal. 2016; 21(1):66.
6. Khambete N, Kumar R. Calcified carotid atherosclerotic plaques on digital panoramic radiographs in patients with Type II diabetes mellitus: A case control study. J Indian Acad Oral Med Radiol. 2015; 27(1):42.
7. Patil SR. Prevalence of carotid artery calcification in postmenopausal women and its correlation with atherogenic risk factors. J Natural Sci Biol Med. 2015; 6(1):S1.
8. Brito ACR, 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. Cienc Saude Col. 2016; 21(7):2201-8.
9. Griniatsos J, Damaskos S, Tsekouras N, Klonaris C, Georgopoulos S. Correlation of calcified carotid plaques detected by panoramic radiograph with risk factors for stroke development. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009; 108(4):600-3.
10. Kumagai M, Yamagishi T, Fukui N, Chiba M. Long-term cigarette smoking increases the prevalence of carotid artery calcification seen on panoramic dental radiographs in male patients. Tohoku J Exp Med. 2007; 212(1):21-5.

(Received June 5, 2018; Accepted February 8, 2019)