

Panoramic radiography for detection of bilateral carotid calcified atheroma: An unusual Case Report.

Radiografía panorámica para la detección de ateroma calcificado carotídeo bilateral: Reporte de un caso inusual.

Maximiliano Bravo-Valenzuela.¹
Javiera Reyes-Velásquez.²
Salvador Valladares-Pérez.^{1,3}

Affiliations:

¹Pontifical Catholic University of Chile, Santiago, Chile.

²Dentistry School, Pontifical Catholic University of Chile, Santiago, Chile.

³El Carmen Metropolitan Clinical Hospital, Maipú, Santiago, Chile.

Corresponding author: Maximiliano Bravo-Valenzuela. Camino la plegaria 6770, La Florida, Santiago, Chile. **Phone:** (56-9) 7690 0878. **E-mail:** mabravo9@uc.cl

Receipt : 06/16/2020 **Revised:** 11/14/2020
Acceptance: 12/27/2020

Abstract: Introduction: Atherosclerosis is a progressive inflammatory disease that can trigger serious medical consequences like acute myocardial infarction or stroke. **Case Report:** The purpose of this study is to report an unusual case of finding calcified atheromatous plaques in the carotid arteries bilaterally using a panoramic radiography (PR). A 75-year-old female with a morbid history, attends the Teaching Dental Clinic of the Pontifical Catholic University with complementary exams. PR showed well-defined radiopaque structures adjacent to C4. Using a Doppler ultrasound, the presence of calcified atheromas in the right and left carotid arteries were confirmed. The patient was informed of these findings and is currently under medical follow-up. **Conclusion:** PR is a useful complementary resource in the detection of atherosclerotic plaques of the upper carotid region.

Keywords: *Plaque; Atherosclerotic; Atheroma; Atherosclerosis; Radiography, Panoramic; Carotid Arteries; Dental Clinics.*

Resumen: Introducción: La aterosclerosis es una enfermedad inflamatoria progresiva que puede desencadenar graves consecuencias médicas como infarto agudo de miocardio o accidente cerebrovascular. **Case Report:** El propósito de este estudio es reportar un caso inusual de hallazgo de placas ateromatosas calcificadas en las arterias carótidas de forma bilateral mediante una radiografía panorámica. Mujer de 75 años con antecedentes mórbidos, acude a la Clínica Odontológica Docente de la Pontificia Universidad Católica con exámenes complementarios. La radiografía panorámica mostró estructuras radiopacas bien definidas adyacentes a C4. Mediante ecografía Doppler se confirmó la presencia de ateromas calcificados en las arterias carótidas derecha e izquierda. El paciente fue informado de estos hallazgos y actualmente se encuentra en seguimiento médico. **Conclusión:** La radiografía panorámica es un recurso complementario útil en la detección de placas ateroscleróticas de la región carotídea superior.

Palabra Clave: *Placa Aterosclerótica; Atheroma; Atherosclerosis; Radiografía Panorámica; Arterias Carótidas; Clínicas Odontológicas.*

Cite as: Bravo-Valenzuela M, Reyes-Velásquez J & Valladares-Pérez S. Panoramic radiography for detection of bilateral carotid calcified atheroma: An unusual Case Report. J Oral Res 2020; 9(6):511-515. **Doi:**10.17126/joralres.2020.097

INTRODUCTION.

Cardiovascular disease (CVD) is one of the main causes of morbidity and mortality in developing countries, and have emerged as a significant public health issue. According to the National Health Survey,¹ Chile has a high prevalence of risk factors of non-communicable diseases. Self-report of acute myocardial infarction includes up to 3.3% of the national population, and up to 10% in people 65 years or older.

Atherosclerosis is a progressive inflammatory disease of the arteries and the aorta that can potentially have multiple consequences, from altering peripheral or coronary vessels, to a myocardial infarction or stroke. The pathogenic mechanisms are not yet fully understood. However, the most accepted hypothesis is the cyclical damage and repair of the endothelial tunica intima for the subsequent early location of an atheromatous plaque core. Risk factors involve hyperlipidemia, diabetes mellitus, smoking, and arterial hypertension. None of

these alone are enough to produce an atherosclerotic lesion. Carotid atheromas occur along the walls of the arterial lumen, commonly near its bifurcation. Fragments can detach into an embolus that may occlude a small intracerebral blood vessel and cause a stroke.

Of the different diagnostic methods, angiography is the “gold standard”. This technique is very invasive and it is not usually indicated in asymptomatic individuals. As such, the use of color Doppler imaging, also called Laser-Doppler flowmetry, Spectral Doppler or Doppler Ultrasonography (DU), has been increasing for the diagnosis of carotid intima-media thickness (cIMT) or atheroma cores due to fast, accurate and painless examination. Its results are comparable to those acquired with angiography, with the advantage of being non-invasive.²

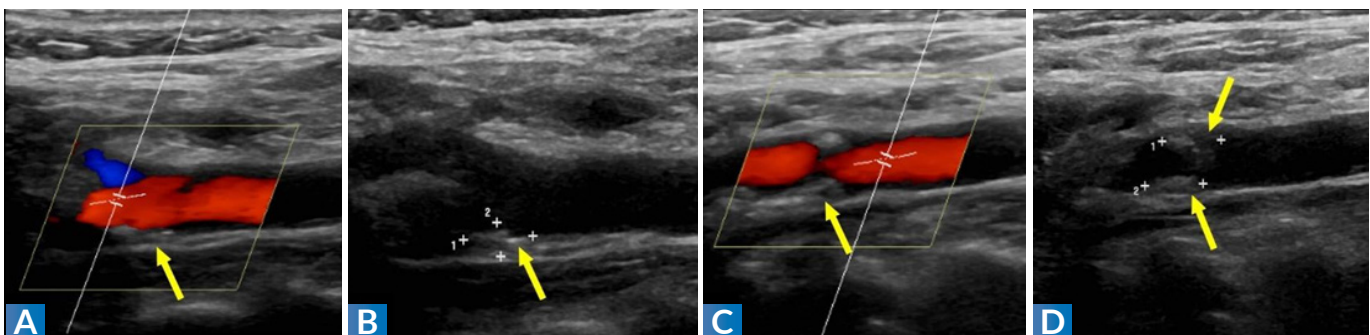
On the other hand, several reports suggest that panoramic radiography (PR), an imaging test frequently used by dentists, may show the presence of calcified

Figure 1. Panoramic radiography of the patient.



A. Maxillary complete edentulism and remaining anterior mandibular teeth are observed. B and C. A close-up view of panoramic radiography. Bilateral radiopaque areas in relation to C4 vertebrae are observed (yellow arrows).

Figure 2. Doppler Ultrasonography.



A and B. Right carotid artery at bulb level. C and D. Left carotid artery at bulb level. Presence of hyperechogenic areas compatible with atheroma plaques in the vascular endothelium (yellow arrows).

carotid artery atheroma (CCAA), as Friedlander-Lander first reported in 1981.³

CCAAs in carotid bifurcation are detectable in 1-5% of the adult population⁴ and most studies report calcification in relation to the C2-C3-C4 cervical vertebrae. The purpose of this study is to report a rare case of bilateral calcified carotid arteries plaques.

CASE REPORT.

A 75-year-old female patient was referred to the oral surgery teaching dental clinic of the Pontifical Catholic University for extraction evaluation of tooth 43 with a poor rehabilitation prognosis. The patient's medical history included hypertension, hypothyroidism, arthritis and depression, under medical and pharmacological control, in addition to a family history of cardiovascular disease. No relevant findings on her physical examination were obtained. Endomorph, with a body mass index of 33.4, obesity class 1.

On the vital sign assessment, a respiratory rate of 18 breaths/minute, a postprandial glycemia of 90mg/dL, a radial pulse of 61 beats/minute and an elevated blood pressure of 179/84mm/Hg were found. The intraoral examination did not contribute to diagnosis. The panoramic radiography (PR) (Figure 1A) showed multiple radiopaque areas, one of which projected at the mandibular angle on the left side, compatible with glandular calcification. In addition, well-defined nodular and vertical radiopaque areas in the inferior and distal region, adjacent to the C4 cervical vertebra were noted, compatible with CCAAs (Figure 1B and Figure 1C).

As advised by their cardiologist, the study was supplemented with a Doppler ultrasound, which revealed internal and external carotid arteries permeable, with an adequate flow signal.

A hyperechogenic plaque at the right carotid bulb was found, 7x3x4mm in size (Figure 2A and Figure 2B). At the left carotid bulb, two hyperechogenic zones 7x4 mm and 7x4.8mm were found (Figure 2C and Figure 2D). No atheroma plaques were evident at the origins of the internal or external carotid arteries. Spectral analysis showed a normal morphological curve, with flow rates at the systolic peak and end of diastole within normal limits.

The diagnosis of bilateral calcified atheroma plaques in the bulb of the carotid arteries was established,

no significant stenosis was found. The patient was informed and is currently being followed up.

DISCUSSION.

In Chile, cardiovascular disease (CVD) is the main cause of death. The burden of this disease represents 12.97% of the disability-adjusted life years, and causes 27.5% of the total deaths, mainly due to stroke (30%) and myocardial infarction (29%).¹ According to the results of the last National Health Survey, the prevalence of risk factors for CVD include 86.7% for sedentary lifestyle, 74.2% for malnutrition due to overnutrition, 12.3% for diabetes mellitus, 33.3% for smoking and 27.6% for arterial hypertension.⁵

This study represents one of the few cases of bilateral calcified carotid arterial plaques reported in the literature.^{4,6-8} CCAAs seen in PR have a prevalence of 0.43-5%, depending on factors like age, sex, and ethnicity.^{9,10} In fact, this prevalence increases to 22-37% in a population with systemic risk factors, such as prediabetes, type 2 diabetes mellitus, kidney disease, among others.^{11,12}

As it is well known, prevention of CVD is less costly than treating its complications. In asymptomatic adults, the detection of subclinical coronary or carotid atherosclerosis can thus be a key point.¹³ Multiple approaches can be done, directly (coronary/carotid artery calcium) or indirectly (carotid intima-media thickness). Previous studies have shown the superiority of CCAAs as a strong and independent predictor of incidence of cardiovascular events compared to cIMT. It has been argued that measurement of total plaque area is a more sensitive and more representative measure of the atherosclerotic burden than cIMT.¹⁴

A study conducted by Mathiesen *et al.*,¹⁴ evaluated 6584 asymptomatic subjects and reported that the risk of stroke increased by 69% with the presence of atheromatous plaques in males (hazard ratio, 1.69; 95% CI, 1.26-2.26; $p < 0.05$) and by 52% in females (hazard ratio, 1.52; 95% CI, 1.08-2.12; $p < 0.05$). Furthermore, this risk could increase in direct proportion according to the total area or volume of the carotid atheromatous plaques.¹⁴ Other studies have also shown that subjects with maximum carotid plaque thickness (cPTmax) greater than 1.9mm had a 2.8-fold increased risk of combined vascular events compared to CCAAs-free-subjects (hazard ratio, 2.80; 95% CI, 2.04-3.84).¹⁵

Sillesen *et al.*,¹⁶ analyzed 5808 asymptomatic subjects using DU with an average follow-up of 3 years. The authors

reported 4.2% major cardiovascular events, including 2.2% deaths (of which 0.5% were cardiovascular, 0.7% MIs and 0.6% ischemic strokes), 0.3% hospitalizations for unstable angina and 1.6% coronary revascularization procedures.

Likewise, according to cPTmax, a risk up to 1.96 times greater of primary major cardiovascular events was observed when compared with participants without carotid atherosclerosis (hazard ratio, 1.96; 95% CI, 0.91-4.25, $p < 0.05$).¹⁶ Similarly, several systematic reviews and meta-analysis in asymptomatic or symptomatic adults have concluded that the evaluation of carotid atheromatous plaques by imaging tests could improve the risk assessment of cardiovascular events.¹⁷

Despite this, unfortunately one of the first clinical manifestations of CCAA is usually a stroke, which occurs when treatment is very late.⁴ CCAAs in PR are well described in the literature, they appear as vertical irregular curvilinear radiopacities, between 1.5cm - 2.5cm inferior and/or posterior to the gonial region of the mandible, close to the level of C2-C3-C4 and posterior to the oropharyngeal space.^{18,19}

Other findings may appear in this region of a PR, such as sialoliths, calcified lymph nodes, tonsilloliths, the stylohyoid complex, phleboliths and the triticeous cartilage.⁹ The latter was an important differential diagnosis for this clinical case, specifically with the radiopacity located in the right carotid artery, due to its well-defined oval shape feature and similar location of calcified carotid atheromas.²⁰ Thus, the imaging tests play a fundamental role in the risk assessment of CCAAs, specifically, regarding blood flow (stenosis), location and size of calcifications.

DU is considered a reference in the diagnosis and should be indicated whenever possible, because it is accurate, non-invasive, painless and relatively economically accessible. PR has become a commonly used imaging modality in dental practice, it is useful because it allows for investigating and screening of disease. Several studies have concluded that CCAAs seen in PR are associated with stroke and MI,²¹ which shows the importance of this exam. Likewise, in a systematic review and meta-analysis, it was concluded that the diagnostic accuracy of PR in detecting CCAAs was good to excellent in 50% of the studies having DU as reference, and also that PR could be used as a method for screening to later be referred to DU and further investigation.²²

CONCLUSION.

Diagnostic screening using panoramic radiography cannot be ignored by dental practitioners. Current recommendations suggest that the patients with a suspicion of CCAAs through this method should be referred to their physician along with complementary exams for a complete evaluation of the cardiovascular system.

On the other hand, this gives dental surgeons an additional responsibility as regards to the diagnosis of this disease, where the careful examination and correct interpretation of panoramic radiographs can be a key factor in detecting one of the main causes of morbidity and mortality.

Conflict of interests: The authors do not have any conflicts of interest (financial or otherwise) relating to products, companies or organizations.

Ethics approval: Not necessary

Funding: No external funding was received for this study.

Authors' contributions: MABV: Investigation: literature search. Writing – original draft; Writing – review & editing. JGRV: Case report; Writing – original draft. SRVP: Case report; Writing – original draft.

Acknowledgements: The authors thank Dr. Javier Ibarra for his participation and help in the radiographic assessment in this study.

REFERENCES.

1. Encuesta Nacional de Salud. Primeros Resultados, 2016-2017. Disponible en: https://www.minsal.cl/wp-content/uploads/2017/11/ENS-2016-17_PRIMEROS-RESULTADOS.pdf.
2. Brito AC, Nascimento HA, Argento R, Beline T, Ambrosano GM, Freitas DQ. Prevalence of suggestive images of carotid artery calcifications on panoramic radiographs and its relationship with predisposing factors. *Cien Saude Colet*. 2016;21(7):2201-8.
3. Friedlander AH, Lande A. Panoramic radiographic identification of carotid arterial plaques. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1981;52:102-104.
4. Lee UK, Chang TI, Garrett N, Friedlander AH. Males with Rheumatoid Arthritis Often Evidence Carotid Atheromas on Panoramic Imaging: A Risk Indicator of Future Cardiovascular Events. *J Oral Maxillofac Surg*. 2018;76(7):1447-1453.
5. Departamento de Estadísticas e Información en Salud (DEIS). Base de Datos de egresos hospitalarios y defunciones. MinSal, Chile, 2015.
6. 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 Investig*. 2010;15(4):563-9.
7. Kumagai M, Yamagishi T, Fukui N, Chiba, M. Carotid artery calcification seen on panoramic dental radiographs in the Asian population in Japan. *Dentomaxillofac Radiol*. 2007;36(2):92-6.
8. Borba DL, Hipólito UV, Pereira YCL. Early diagnosis of atherosclerosis with panoramic radiographs: a review. *J Vasc Bras*. 2016;15(4):302-7.
9. Magat G, Tuncdemir AR. Assessment of calcified carotid artery plaques on digital panoramic radiographs of middle-aged and older asymptomatic persons in a Turkish subpopulation and associated risk factors. *Iran Red Crescent Med J*. 2018; 20:0-6.
10. Monteiro IA, Ibrahim C, Albuquerque R, Donaldson N, Salazar F, Monteiro L. Assessment of carotid calcifications on digital panoramic radiographs: Retrospective analysis and review of the literature. *J Stomatol Oral Maxillofac Surg*. 2018;119(2):102-6.
11. Kansu O, Ozbek M, Avcu N, Gençtoyg G, Kansu H, Turgan C. The prevalence of carotid artery calcification on the panoramic radiographs of patients with renal disease. *Dentomaxillofac Radiol*. 2005; 34:16-9.
12. Friedlander AH, El Saden SM, Hazboun RC, Chang TI, Wong WK, Garrett NR. Detection of carotid artery calcification on the panoramic images of post-menopausal females is significantly associated with severe abdominal aortic calcification: a risk indicator of future adverse vascular events. *Dentomaxillofac Radiol*. 2015;44(7):20150094.
13. Baber U, Mehran R, Sartori S, Schoos MM, Sillesen H, Muntendam P, Garcia MJ, Gregson J, Pocock S, Falk E, Fuster V. Prevalence, impact, and predictive value of detecting subclinical coronary and carotid atherosclerosis in asymptomatic adults: the BioImage study. *J Am Coll Cardiol*. 2015;65(11):1065-74.
14. Mathiesen EB, Johnsen SH, Wilsgaard T, Bønaa KH, Løchen ML, Njølstad I. Carotid plaque area and intima-media thickness in prediction of first-ever ischemic stroke: a 10-year follow-up of 6584 men and women: the Tromsø Study. *Stroke*. 2011;42(4):972-8.
15. Rundek T, Arif H, Boden-Albala B, Elkind MS, Paik MC, Sacco RL. Carotid plaque, a subclinical precursor of vascular events: the Northern Manhattan Study. *Neurology*. 2008;70(14):1200-7.
16. Sillesen H, Sartori S, Sandholt B, Baber U, Mehran R, Fuster V. Carotid plaque thickness and carotid plaque burden predict future cardiovascular events in asymptomatic adult Americans. 2017;1-9.
17. Deng F, Mu C, Yang L, Li H, Xiang X, Li K, Yang Q. Carotid plaque Magnetic Resonance Imaging and Recurrent stroke Risk: a systematic review and meta-analysis. *Medicine*. 2020;99:13(e19377)
18. MacDonald D, Chan A, Harris A, Vertinsky T, Farman AG, Scarfe WC. Diagnosis and management of calcified carotid artery atheroma: dental perspectives. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2012; 114(4):533-47.
19. Barona-Dorado C, Gutierrez-Bonet C, Leco-Berrocal I, Fernández-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):e66-e71.
20. Ahmad M, Madden R, Perez L. Triticeous cartilage: Prevalence on panoramic radiographs and diagnostic criteria. *Oral Surgery, Oral Med Oral Pathol Oral Radiol Endodontology*. 2005;99(2):225-30.
21. Bengtsson VW, Persson GR, Berglund J, Renvert S. Carotid calcifications in panoramic radiographs are associated with future stroke or ischemic heart diseases: a long-term follow-up study. *Clin Oral Investig*. 2018;23(3):1171-9.
22. Schroder AGD, de Araujo CM, Guariza-Filho O, Flores-Mir C, Luca Canto G, Porporatti AL. Diagnostic accuracy of panoramic radiography in the detection of calcified carotid artery atheroma: meta-analysis. *Clin Oral Investig*. 2019;23(5):2021-2040.