Ann Med Res

Current issue list available at AnnMedRes

Annals of Medical Research

journal page: www.annalsmedres.org

Investigation of calcified atherosclerotic plaques on panoramic radiographs

Ali Altindag

Necmettin Erbakan University, Faculty of Dentistry, Department of Dentomaxillofacial Radiology, Konya, Türkiye

ARTICLE INFO

Keywords:
Calcification
Carotid artery
Panoramic radiography
Soft tissue

Received: Dec 07, 2023
Accepted: Jan 25, 2024
Available Online: 26.01.2024

DOI:
10.5455/annalsmedres.2023.12.323

Abstract

Aim: This study aims to determine the prevalence of calcified atherosclerotic plaques (CAPs) incidentally encountered in the carotid artery within panoramic radiography (PR) images.

Materials and Methods: A total of 1,200 patients (646 females, 554 males) referred to our clinic in January 2022 and January 2023 was included. CAPs within PRs were assessed, with data stratified by gender, age, and systemic conditions. Statistical analysis employed descriptive statistics and chi-square tests ($p<0.05$).

Results: Among the 1200 patients, 251 CAPs (20.92%) were detected, with 128 (50.1%) occurring in females and 123 (49.9%) in males. The gender-based analysis demonstrated no statistically significant disparity in CAPs occurrence. Conversely, a statistically significant difference was detecdet in the frequency of CAPs between age groups and systemic conditions ($p<0.05$).

Conclusion: Panoramic radiography, routinely used in dental practice, offers a cost-effective, low-radiation means for preliminary CAPs assessment. Dental practitioners should consider referring patients with identified CAPs in PRs to cardiology departments, potentially reducing stroke risks.

Introduction

In the maxillofacial region, instances of soft tissue calcifications are relatively uncommon and are typically identified through routine examinations involving panoramic radiography (PR). These calcifications often present without conspicuous signs or symptoms, and their reported prevalence varies within the range of 2% to 19% [1, 2]. In instances where the detection of soft tissue calcifications transpires, critical diagnostic parameters encompass their anatomical localization, numerical abundance, spatial dispersion, dimensions, and morphological attributes [3]. The discernment of such calcifications becomes notably intricate when they are superposed upon underlying anatomical structures [4]. Hence, possessing a comprehensive understanding of both soft and hard tissue anatomy within the pertinent region is imperative [3].

Furthermore, instances, wherein soft tissue calcifications are proximal to bony structures, pose complexities in distinguishing whether the calcification pertains to soft tissue or osseous tissue. Addressing this necessitates a thorough patient anamnesis, comprehensive clinical examination, potential acquisition of radiographs from alternative angles, or recourse to advanced imaging modalities [5]. Differential diagnosis necessitates a meticulous consideration of anatomical constructs including the styloid process, epiglottis, hyoid bone, triticeous cartilage, and upper horns of the thyroid cartilage [5]. Epidemiologically, the prevalence of these calcifications predominantly aligns with individuals aged 40 and above, albeit instances involving pediatric cases have also been documented [6].

Calcifications that arise within regions of endothelial damage in the intimal layer of vessels are denoted as atherosclerotic plaques [7]. These plaques predominantly manifest at the carotid bifurcation site, corresponding to the C3-C4 vertebrae level, and within the posteroinferior aspect of the mandibular angle. Notably, they are recognized within the soft tissue characterized by an irregular structure, displaying marked heterogeneity and multiplicity (Figure 1) [7, 8]. Recent investigations have unveiled the feasibility of identifying atherosclerotic plaques, originating at the juncture where the carotid artery branches into external and internal components, via panoramic radiography (PR) [9, 10]. These studies have indicated a prevalence range of carotid artery calcifications detected through PRs to be

*Corresponding author:
Email address: alialtindag1412@gmail.com (Ali Altindag)

between 3% and 4.5% in individuals aged over 50 [9, 11]. Additionally, certain studies have indicated a heightened prevalence of such calcifications among diabetic patients in contrast to their healthy individuals [11].

Recognition of calcified atheroma plaque occurrences by dental practitioners within routine panoramic radiographs holds the potential for early diagnosis of cerebrovascular and embolic ailments that may culminate in debilitating conditions or mortality [7, 8].

This study aims to evaluate the prevalence of calcified atherosclerotic plaques (CAPs), which are seen in panoramic radiographs taken for various diagnostic reasons. Thus, the identification and subsequent referral of patients within the risk group to specialized physicians hold significant importance for the quality of life of individuals. In this study, the frequency of observing calcified artery plaques (CAPs) in patients was assessed, and their associations with age, gender, and systemic health conditions were examined.

Materials and Methods

This study obtained ethical approval from the Ethics Committee of Necmettin Erbakan University, Faculty of Dentistry (Date: 27/04/2023, decision no: 2023/272). The study was carried out in accordance with the International WHO Declaration of Helsinki.

The type of study

The research design employed in this investigation can be categorized as a retrospective, descriptive, and cross-sectional study. In the context of power analysis performed utilizing the G-power software, the determination of the total sample size resulted in a calculation of 326 individuals. This calculation was based on a specified Cohen's d effect size of 0.25, characterizing a relatively modest effect size. Additionally, the alpha error was set at 0.05, while the statistical power was established at 0.80, signifying a robust level of statistical power.

Data collection

The panoramic radiographs (PR) analyzed in this research were randomly selected from individuals who were referred to the Oral and Maxillofacial Radiology Department of Necmettin Erbakan University Faculty of Dentistry between January 2022 and January 2023.

The PRs were obtained using the Morita Veraviewepocs 2D panoramic unit (J Morita MFG Corp., Kyoto, Japan), employing parameters of 60-70 kVp, 5-7 mA, and 6-8 s exposure times in accordance with the manufacturer's guidelines. All data were meticulously assessed by a single maxillofacial radiologist and conducted under ambient lighting conditions on an LCD monitor. To ascertain within-observer consistency, a subset of 100 images was subjected to reevaluation after a 3-week interval. Panoramic radiographs were categorized based on the criteria outlined by the United Kingdom National Radiological Protection Board [12] into three classifications: 1. diagnostically excellent, 2. diagnostically acceptable, and 3. diagnostically unacceptable. Radiographs assigned a Grade 1 designation exhibit no discernible exposure, positioning, or rendering errors. Grade 2 radiographs may display minor exposure, positioning, or rendering errors. Conversely, Grade 3 radiographs manifest notable exposure, positioning, or processing errors, and it is strongly advised against evaluating these radiographs. Furthermore, the guidelines recommend that a minimum of 70% of radiographs should attain Grade 1 status to ensure the validity of the assessment [13]. Consequently, for the purposes of assessing validity and reliability, only Grade 1 images of individuals aged 18 years and above were incorporated, resulting in the inclusion of 1200 out of the initially evaluated 1400 images.

Statistical analysis

Statistical evaluation of the association between calcified atherosclerotic plaques (CAPs) and variables such as gender, age groups, and systemic diseases was performed through the employment of the chi-square test alongside descriptive statistical methods. The analyses were executed utilizing the IBM SPSS Statistics 21.0 program. A p-value threshold of <0.05 was adopted to establish statistical significance.

Results

Digital panoramic radiographs were assessed unilaterally or bilaterally (Figure 1) by an experienced maxillofacial radiologist based on the presence of calcified carotid atheroma after excluding other calcifications in the carotid artery region, such as thyroid cartilage, triticeous cartilage, and calcified lymph nodes. Distinguishing between CAPs and other calcifications; 1.Density and Configuration (the shape and radiopacity of the calcifications, considering the irregular or plaque-like appearance) 2.Location and Anatomical Correlation (anatomical landmarks and correlation of the observed calcifications with the expected location of the carotid arteries) 3.Association with Known Structures (differentiating features might include assessing whether the calcifications are closely associated with the expected course of the carotid arteries or if they align more with other structures like thyroid or triticeous cartilage) 4.Size and Morphology (size and morphology could be important criteria. Atheromas might present with specific dimensions and morphological characteristics that differ from other types of calcifications) 5.Consistency with Atherosclerotic Patterns, mentioned criteria were taken into consideration.

The calculated Kappa coefficient for intra-observer agreement yielded a substantial value of 0.927.

A comprehensive cohort comprising 646 females (53.8%),

Table 1. Descriptive statistics of patients by gender and age.

	Female	Male	Total
n	646	554	1200
Mean(Age)	35.94	36.86	37.09
Std.Deviation	13.77	13.93	13.79
Minimum	18	18	18
Maximum	84	80	84

Table 2. χ^2 Tests, and the distribution of subjects according to the prevalence of CAPs, age groups, gender, associated risk factors, and p value.

		CAPs		
	Total	Absence	Presence	p value
Age Groups				
18-35	345(28.8%)	329(27.4%)	16(1.4%)	
36-60	423(35.2%)	326(27.1%)	97(8.1%)	*0.001
61 +	432(36%)	314(26.1%)	138(9.9%)	
Gender				
Female	646(53.8%)	518(43.1%)	128(10.7%)	*0.456
Male	554(46.2%)	431(35.9%)	123(10.3%)	
Diabetes M.				
Absence	1064(88.6%)	846(70.5%)	218(18.1%)	*0.398
Presence	136(11.4%)	103(8.6%)	33(2.8%)	
Hypertension				
Absence	1016(84.6%)	867(72.2%)	149(12.4%)	*0.002
Presence	184(15.4%)	82(6.9%)	102(8.5%)	
DM + Hypertension				
Absence	1074(89.5%)	899(74.9%)	175(14.6%)	*0.001
Presence	126(10.5%)	41(3.4%)	76(7.1%)	

ranging in age from 18 to 84, and 554 males (46.2%), aged between 18 and 80, underwent scanning (Table 1).

Notably, no statistically significant distinction was evident in the mean age comparison between females (35.94±13.77) and males (36.86±13.93). The overall mean age for the 1200 subjects encompassed in this investigation was 37.09 ± 13.79 years. Within this study, the occurrence of CAPs was noted in 128 (50.1%) female patients and 123 (49.9%) male patients (Table 2). It is noteworthy that no statistically significant variance was observed in relation to CAPs and gender ($p>0.05$).

Categorization of the individuals into three distinct age groups was carried out (Table 2). The first group comprised individuals aged 18 to 35, the second encompassed those aged 36 to 60, and the third consisted of individuals aged 61 and above. Evaluation of these groups revealed that among the first group, encompassing 345 (28.8%) patients, 16 displayed CAPs. In the second group, consisting of 423 (35.2%) patients, CAPs were detected in 97 cases. Similarly, within the third group, composed of 432 (36%) patients, CAPs were identified in 138 instances (Table 2).

A total of 1200 patients, 756 individuals were deemed to be systemically healthy, while 446 presented with at least one systemic disease. Among the 251 identified CAPs, 40 were present in the group devoid of systemic diseases, while the remaining 211 were observed in individuals with distinct conditions such as diabetes mellitus (DM), hypertension (HT), and the combination of DM and HT. Specifically, the occurrences were 33, 102, and 76 for DM, HT, and DM+HT, respectively. It is noteworthy that while no significant discrepancy was noted between CAPs presence

Figure 1. Bilateral CAPs at the level of C3-C4 vertebrae in a patient with diabetes mellitus and hypertension.

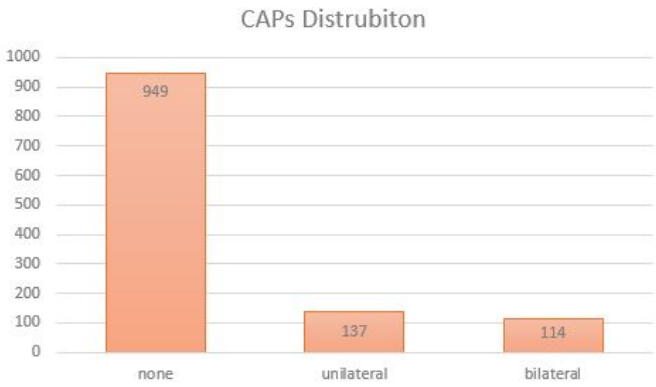

Figure 2. Numerical distribution of CAPs is seen in the bars none, unilaterally or bilaterally.

and the presence of DM, a statistically significant association was established between HT and DM+HT ($p<0.05$) (Table 2).

Of the detected CAPs, 65 (5.42%) were situated on the right side, 72 (6%) on the left, and 114 (9.5%) exhibited bilateral manifestations (Figure 1, 2).

Discussion

Atherosclerotic cardiovascular diseases constitute a range of medical conditions encompassing both fatal and non-fatal manifestations, including coronary artery diseases (myocardial infarction, angina), ischemic cerebrovascular diseases (stroke), and peripheral arterial diseases. In the context of routine dental procedures, panoramic radiographs (PRs) hold the potential for identifying calcified atherosclerotic plaques (CAPs), acknowledged as a risk factor for stroke [1, 14] Dentists are proficient in discerning CAPs amidst anatomical and pathological structures, contributing to refined differential diagnoses [10, 14]. Given the critical significance of early diagnosis and intervention in preserving health, this study sought to establish the prevalence of CAPs within PRs acquired from patients referred to our clinic for assessment and therapeutic interventions.

Within dental practice, the timely recognition of CAPs is endorsed as a critical intervention toward mitigating stroke susceptibility. However, extant literature underscores the combination of color Doppler ultrasound with PRs as the gold standard for CAPs identification [1]. The study's

inability to definitively validate CAPs detection through Doppler ultrasound emerges as a noteworthy study limitation.

Research endeavors appraising the prevalence of CAPs through PRs have divulged a spectrum of occurrence rates spanning from 4.5% to 41% [1, 10]. In a study appraising CAPs prevalence within the Japanese populace, the incidence was documented at 5% [15]. A comparative analysis between male individuals and smokers has yielded observations indicating a greater stroke risk among men, particularly when juxtaposed with non-smokers [16]. The lack of assessment of lifestyle factors such as smoking and dietary habits can be considered among the limitations of the study.

Sisman et al. [16] reported a prevalence of 5.06% for calcified atherosclerotic plaques (CAPs) in panoramic radiographs (PRs) from 750 patients aged over 40 in the Cappadocia region. This prevalence was delineated as 3.46% for unilateral CAPs and 1.6% for bilateral CAPs. Moreover, it was established that there existed no statistically significant distinction in CAPs prevalence between genders. In the context of age disparity and CAPs prevalence, this study's findings indicated no statistically significant variance between the males and females. Consequently, the results of the present study demonstrate concordance with the findings of Sisman et al., while disparities in prevalence rates can potentially be attributed to variances in age group compositions within the study participants. Furthermore, the incidence of unilateral CAPs (11.42%) exceeded that of bilateral CAPs (9.5%) within this study, aligning with the outcomes of the aforementioned study and corroborating reports in the literature [1, 16]. However, it is important to acknowledge that literature also contains studies showcasing a higher prevalence of bilateral CAPs [17].

Upon stratifying the CAPs based on location, the findings indicated a higher prevalence of CAPs on the left side (6%) in contrast to the right side (5.1%) within this study. While Ertaş and Sisman [17] reported a lack of statistically significant difference between the right and left regions. The literature evidently lacks consensus regarding the specific regional predilection for CAPs settlement. Moreover, the underlying factors precipitating their occurrence in either the right or left regions remain unexplored within the current body of scholarly work.

The investigation conducted in this study revealed that the prevalence of calcified atherosclerotic plaques (CAPs) did not exhibit a statistically significant divergence with respect to gender ($p>0.05$). These findings are consistent with prior research endeavors by Atalay et al.[18] and Mağat and Tunçdemir [1]. However, it is noteworthy that the outcomes of this study stand in contrast to the findings reported by Janiszewska-Olszowska et al. [19]. In their study, CAPs were identified in 60.68% of female patients and 39.32% of male patients.

Within the purview of panoramic radiographs (PRs), the prevalence of CAPs is notably augmented among elderly individuals, particularly those aged 45 and above. Notably, a specific investigation indicated a statistically significant escalation in CAPs prevalence among subjects aged 61 years and older [1]. In this age cohort, the prevalence of CAPs was recorded as 9.9%. Nevertheless, it is pertinent to acknowledge the study by Taheri and Moshfeghi [20], which focused on postmenopausal women and determined no significant correlation between age and CAPs prevalence. Consequently, the findings underscore the importance of systematically examining PRs across all age groups, notwithstanding the variations in CAPs prevalence due to age-related factors.

Magat and Tuncdemir [1], and Taheri et al. [20] reported that 64%, 81%, and 86% of individuals exhibiting calcified atherosclerotic plaques (CAPs), respectively, possessed at least one associated risk factor. Analogous to these cited investigations, the present study divulged a CAPs prevalence of 84.06% among subjects with at least one correlated systemic ailment. In contrast, Barona et al. [21] documented an elevated incidence of CAPs in panoramic radiographs (PRs) of diabetic patients. However, this finding contradicts the outcomes of the current study. Notably, within the present research, the prevalence of CAPs among diabetic patients was not substantively elevated, aligning more closely with the findings of Atalay et al. [18], and Magat and Tuncdemir [1].

Johansson et al. [22] observed that there was no substantial disparity in the prevalence of calcified carotid artery plaques (CAPs) between individuals with hypertension (HT) and those without. In contrast, MacDonald et al. [11] identified hypertensions as a significant contributing factor to the development of atheroma. Within the purview of the present study, heightened CAPs prevalence was evident in patients diagnosed with HT and those afflicted by both diabetes mellitus and HT (DM+HT) (Table 2). Variations in study outcomes could potentially be attributed to factors such as sample size disparities, ethnic variations, divergent lifestyle patterns, and dietary habits.

Marinho et al. [23] conducted an investigation encompassing 67 patients afflicted by liver cirrhosis and an equivalent number of healthy controls. Their findings indicated that individuals with liver cirrhosis exhibited a 3.72-fold elevated likelihood of possessing calcified atherosclerotic plaques (CAPs) in comparison to their healthy counterparts. Furthermore, the study underscored that the presence of nephropathies among cirrhotic patients amplified the risk by a substantial factor of 18.58.

Taneja [24] evaluated the panoramic radiography of 700 patients over the age of 30, and 358 of these radiographs that met diagnostic quality were included in the study. CAPs were detected in a total of 82 (22.9%) radiographs. They also found that the presence of CAPs were associated with increasing age, male gender, smoking, and hypertension. Their findings are compatible with the results of the present study.

Annapoorani et al. [25] conducted an analysis involving panoramic radiographs from a cohort of 22,000 individuals spanning an age range of 6 to 88 years (mean age 41 $\pm$ 11.4 years). Within this large cohort, 1228 individuals displayed soft tissue calcification, with 139 of them (0.006%) having calcified atherosclerotic plaques. The observed disparities in prevalence rates could potentially be attributed to variations in racial composition and age distribution among the studied populations.

Several limitations merit consideration within the purview of this study. The sample size was primarily constrained to individuals seeking dental treatment, potentially affecting the cohort's representativeness. Furthermore, the retrospective design hampered the comprehensive collection of patients' medical histories, which would encompass pertinent factors like weight, height, body mass index (BMI), tobacco and alcohol consumption, medication usage, and duration of pharmacological interventions for various medical conditions.

Conclusion

Identification of cardiovascular pathologies relies on the detection of calcified atherosclerotic plaques (CAPs); this can be achieved through the use of panoramic radiographs (PRs). Although PRs are not the most definitive method for CAPs imaging, they can prompt referral to a cardiologist for further diagnosis if a finding is spotted. Dentists play a crucial role in reviewing PRs to uncover potential cardiovascular issues. Identifying such calcifications is vital for diagnosing and preventing disorders in asymptomatic high-risk patients. Dentists should meticulously examine the carotid artery region on PRs in both individuals with and without systemic diseases. The execution of more comprehensive, prospective studies is needed to unravel the nuances of this matter in greater depth.

Conflict of interest

The author declares that there is no conflict of interest.

Ethical approval

This study was approved by the Necmettin Erbakan University Ethics Committee (Date: 27.04.2023, decision no: 2023/272). The study was carried out following the international declaration, guidelines.

Author contributions

Concept – AA; Supervision – AA; Materials – AA; Data Collection and/or Processing – AA; Analysis and/or Interpretation – AA; Writing – AA.

References

1. 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. doi:10.5812/ircmj.63780.
2. Valiyaparambil J, Rengasamy K, Mallya SM. An unusual soft tissue radiopacity– radiographic appearance of a dermal filler. Br Dent J. 2009;207(5):211-2. doi:10.1038/sj.bdj.2009.764.
3. 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(1):51.
4. Balaji Babu B, Avinash Tejasvi M, Avinash CA, Chittaranjan B. Tonsillolith: a panoramic radiograph presentation. J Clin Diagn Res. 2013;7(10). doi:10.7860/JCDR/2013/5613.3530.
5. White S, Pharoah M. Principles and interpretation of Oral Radiology. Amsterdam: Elsevier; 2014.
6. Agacayak KS, Guler R, Sezgin Karatas P. Relation between the incidence of carotid artery calcification and systemic diseases. Clin Interv Aging. 2020;821-826. doi:10.2147/CIA.S256588.
7. Avsever H, Orhan K. Çene Kemiği ve Çevre Dokuları Etkileyen Kalsifikasyonlar. Turkiye Klinikleri J Oral Maxillofac Radiol-Special Topics. 2018;4(1):43-52.
8. Noffke C, Raubenheimer E, Chabikuli NJ. Radiopacities in soft tissue on dental radiographs: diagnostic considerations: clinical review. S Afr Dent J. 2015;70(2):53-7.
9. Scarfe WC, Farman AG. Soft tissue calcifications in the neck: Maxillofacial CBCT presentation and significance. AADMRT Currents. 2010;2(2):3-15.
10. Alves N, Deana NF, Garay I. Detection of common carotid artery calcifications on panoramic radiographs: prevalence and reliability. Int J Clin Exp Med. 2014;7(8):1931- 39.
11. 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. doi:10.1016/j.oooo.2012.06.02012.
12. Gribben M. Public Health England (PHE) and Faculty of General Dental Practice (UK)(FGDP (UK)) Guidance notes for dental practitioners on the safe use of X-ray equipment 2020: An update for the dental team. Dent Update. 2021;48(9):719-724. doi.org/10.12968/denu.2021.48.9.719.
13. Eren H, Sezer B, Deniz Y. Evaluation of the differences in the localization of the lingula mandibulae according to pubertal development in children: A new anthropological and forensic approach. Arch Oral Biol. 2024;105892. doi.org/10.1016/j.archoralbio.2024.105892.
14. Prados-Privado M, Villalon JG, Torres AB, Martinez CH, Prados-Frutos JC, Ivorra C. Are Panoramic Images a Good Tool to Detect Calcified Carotid Atheroma? A Systematic Review. Biology. 2022;11(11):1684. doi:10.3390/biology11111684.
15. Peters SA, Huxley RR, Woodward M.Smoking as a risk factor for stroke in women compared with men: A systematic review and meta-analysis of 81 cohorts, including 3 980 359 individuals and 42 401 strokes. Stroke J. 2013;44(10):2821-28. doi:10.1161/STROKEAHA.113.002342.
16. Sisman Y, Ertas ET, Gokce C, Menku A, Ulker M, Akgunlu F. The prevalence of carotid artery calcification on the panoramic radiographs in Cappadocia region population. Eur J Dent. 2007;1(03):132-8.
17. Ertas ET, Sisman Y. Detection of incidental carotid artery calcifications during dental examinations: panoramic radiography as an important aid in dentistry. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2011;112(4):e11-e17. doi:10.1016/j.tripleo.2011.02.048.
18. Atalay Y, Asutay F, Agacayak KS, Koparal M, Adali F, Gulsun B. Evaluation of calcified carotid atheroma on panoramic radiographs and Doppler ultrasonography in an older population. Clin Interv Aging. 2015;10:1121-1129. doi:10.2147/CIA.S84683.
19. Janiszewska-Olszowska J, Jakubowska A, Gieruszczak E, Jakubowski K, Wawrzyniak P, Grocholewicz K. Carotid Artery Calcifications on Panoramic Radiographs. International Journal of Environmental Research and Public Health. 2022;19(21):14056 doi:10.3390/ijerph192114056.
20. Taheri JB, Moshfeghi M. Prevalence of calcified carotid artery on panoramic radiographs in postmenopausal women. J Dent Res Dent Clin Dent Prospect. 2009;3:46–51. doi:10.5681/joddd.2009.011.
21. 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):66-71. doi:10.4317/medoral.20183.
22. Johansson E, Ahlqvist J, Garoff M, Jäghagen EL, Meimermondt A, Wester P. Carotid calcifications on panoramic radiographs: a 5-year follow-up study. Oral Surg Oral Med Oral Pathol Oral Radiol. 2015;120(4):513-20. doi:10.1016/j.oooo.2015.06.026.
23. Marinho GB. Tenório JR, Munhoz L, Andrade NS, Arita ES, Ortega KL. Detection of calcified atheromas on panoramic radiographs of cirrhotic patients. Spec Care Dent. 2021;41(2):164-169. doi:10.1111/scd.12551.
24. Taneja A. Calcified carotid artery atheroma on standard dental panoramic radiographs in a dental school population: a retrospective study. University of British Columbia, Faculty of Dentistry, Master of Science Thesis, Vancouver, Canada. 2023.
25. Annapoorani S, Thambi JR, Christy W. A retrospective diagnostic study of prevalence of orofacial calcifications using panoramic radiograph: To insinuate the unseen. J Clin Exp Dent. 2023;15(4):e289. doi:10.4317/jced.60224.