

## Panoramic Radiograph Used As a Diagnostic Tool in Identification of Carotid Artery Calcification in Underlying Vascular Disease – A Retrospective Study

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**Abstract:** Calcification in the carotid artery (CACs) can be visible in the panoramic radiographs (PRs) near the region of the cervical vertebrae C3-C4, posterior to angle of mandible. The aim of this study was to evaluate the incidence of CACs on PRs and their linkage with hypertension, age, gender and smoking habits. PRs of 2000 patients were evaluated. The age group was chosen between 20 to 70 year old people and their PRs had been taken for different clinical reasons. Information about smoking habits, hypertension and other vascular events was obtained from OPD case papers. The observers analyzed the presence of radiopaque mass in the region of posterior to angle of mandible bilaterally on PRs. The results showed a 0.6 % incidence of CACs on 2000 PRs. In our study no significant relationship was found between smokers and incidence of carotid artery calcification. In our study significant statistical correlation found between CVD and PAD and associated risk factor with CAC on panoramic radiographs. **Keywords:** Panoramic Radiograph (PRs), Carotid Artery Calcification (CACs), Arterial Hypertension, Stroke, (PAD) peripheral artery diseases, cardiovascular disease (CVD).

### INTRODUCTION

The radiographic examination is an essential step in diagnosis and treatment planning [1]. The value of any diagnostic procedure depends on the amount and accuracy of the information that can be derived from it. Among the various diagnostic procedures radiographs are indispensable and are one of the chief diagnostic aids which allow the clinician to view the internal components of the oral structures and provide information to supplement clinical examination [2].

Panoramic radiography is a simplified extra oral radiographic procedure which visualizes the entire maxillofacial complex on a single film has become a valuable adjunct to conventional extra oral radiographic procedures. The simplicity of the operation, the broadened scope of examination, the ability to project anatomic structures in their normal relationship with reduced superimpositions of intervening parts and low radiation dosage are reasons for its widely growing popularity.

Panoramic radiography is one of the most common informative radiographs in dentistry [3]. The radiation exposure is relatively small compared with full periapical radiographs and it is quick and easy to

perform. Panoramic radiography provides a rapid, low cost overview of the teeth and jaw.

Panoramic radiography is useful in studying the growth and development, resorption and eruption patterns the TMJ, the sinuses and mastoid regions, mandibular –morphology and neoplasm, cysts, supernumerary teeth and ankylosis.

Additionally panoramic films are useful for making dimensional assessments of the bone for the location of implants and determining relative angulations of the teeth with other structures [5].

Panoramic radiography is frequently used to visualize root parallelism and mesio-distal tooth

angulation, the relative position of the root & resorptive abutments.

Panoramic radiography is a simple technique for demonstrating all the teeth & their supporting structures i.e. one radiograph with a full mouth set of periapical radiographs. It is less time consuming more comfortable for patient and involves considerably less radiation, however the Panoramic radiography has major limitations only those within the focal trough are clearly seen while air spaces, soft tissues and ghost images can be projected over the region.

There is also an inherent loss of image quality associated with the use of a screen film combination compared with intra oral film although image quality has improved with newer equipment but it is still inferior to intra oral radiography.

Panoramic radiography is less accurate than intra oral radiography for the most common dental conditions, caries, periodontal and periapical diseases. The diagnostic yield of Panoramic radiography is assessed to use in diagnosis of soft tissue calcification including carotid artery, lymphomas, stylohyoid chain.<sup>5</sup>

Various systemic diseases cause calcification in carotid artery which can be seen in Panoramic radiography like atherosclerosis. It tends to accumulate within the bifurcation of the common, external & internal carotid arteries these calcifications appear as heterogeneous radiopacities near the hyoid bone at the level of C3 & C4 intervertebral space [3-6]. They could appear as nodular radiopaque masses or vertical lines inferior or posterior to angle of the mandible [7].

Calcification of arteries may not always be noticed on the panoramic radiograph showing to the fact that not all atherosclerotic lesions are calcified, so panoramic radiography are good but not sufficient screening tools for carotid calcification and advanced diagnostic examinations. So careful examination in the area of carotid artery in the patients with various systemic diseases is advisable [7].

On historical aspect, presence of carotid artery calcifications on panoramic radiographs was 1<sup>st</sup> showed by Friedlander and Lander. They suggested that these radiographs were able to play an important role in the early diagnosis of CAC which could result in more serious heart disease and cerebrovascular accident, therefore PRs may help us as a diagnostic tool for detecting CAC & early diagnosis could potentially decrease the morbidity and mortality for subjects with CACs [8].

CACs, especially close to carotid bifurcation, can result in important vascular obstruction causing stroke [9].

Non modifiable risk factors:

- Gender
- Age
- Ethnicity
- Heredity

Modifiable risk factors are: -

- Hypertension
- Diabetes mellitus
- Hyperlipidemia
- Obesity
- Smoking
- Carotid atherosclerosis disease

CACs found as incidental findings on standard PRs may be important markers for future coronary artery disease, stroke & death. It could provide life – saving information [10].

A number of anatomic and pathologic radiopacities seen in the PR which are [11].

- Sialolith
- Calcification of stylohyoid ligament
- Elongated styloid process
- Calcified thyroid cartilage
- Calcified triticeous cartilage
- Calcified lymph node

Most of them are readily distinguishable on the basis of location and morphological features. The PRs are used as another diagnostic tool for evaluation and predisposition to systemic diseases in density and increase in porosity beginning in approximately the 3<sup>rd</sup> decade of life [12, 13].

## MATERIALS AND METHOD

### Source of data

The study is based on 2000 PRs taken and archived in the dept. of oral medicine & radiology for various indications. All PRs had been taken using a single Kodak 8000 C (Eastman Kodak Company, France) panoramic radiography unit. Medical history of these patients which was given at their first visit was also checked in the record room.

### Inclusion criteria

We surveyed 2000 PRs of those patients who had attended our dental college for a variety of reasons and had undergone a panoramic radiographic examination as part of their treatment out of them 1386 were included in the current study. PRs of good optimal diagnostic quality free from any artifact and those demonstrated the inferior border of the orbits superiorly, the hyoid bone below the lower border of the mandible inferiorly, and the presence of the mandibular condyles and mastoid process bilaterally.

### Exclusion criteria

Undiagnostic, poor image quality panoramic radiographs. PRs those did not include C3 and C4 and unable to detect SP were eliminated. Undefined mental foramen and/or those PRs also excluded due to unable to detect inferior mandibular cortex borders. Patients whose medical history information were not found excluded from this study

**METHOD OF COLLECTION OF DATA**

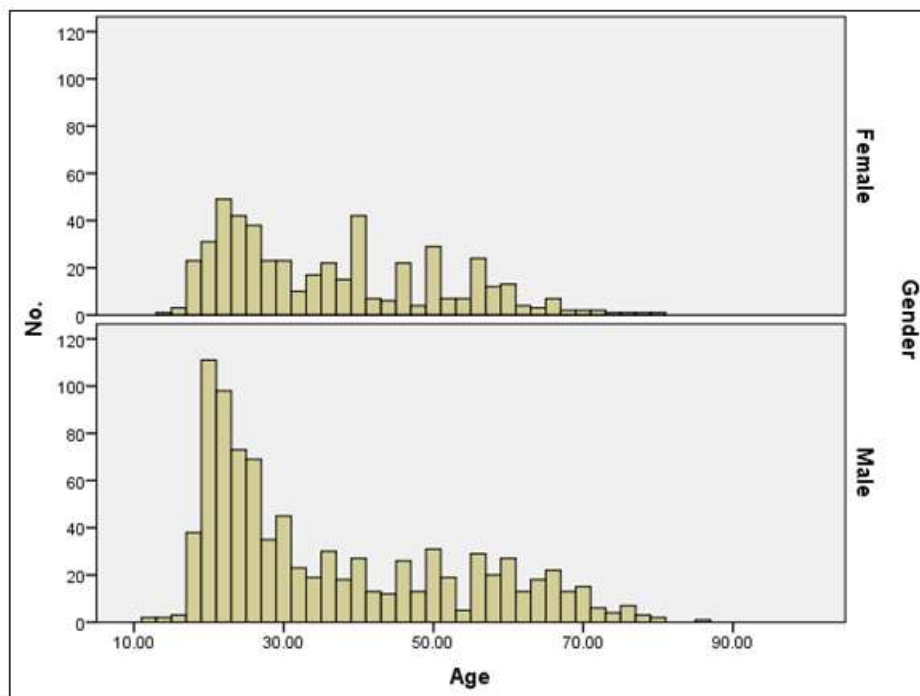
Data were abstracted from the panoramic radiographs and medical history record charts. All OPGs were viewed through Philips DICOM Viewer R 2.5 Version 1 Level 1 and all linear measurement were performed by using this software.

**For Carotid artery calcifications**

A radiopaque nodular mass or masses adjacent to the cervical vertebrae at or below the intervertebral space between C3 and C4 were diagnosed as CACs. For the differential diagnosis of CACs, other cervical calcifications such as calcified triticeous cartilage, calcified thyroid cartilage, hyoid bone and submandibular salivary gland sialoliths were excluded.

**RESULTS**

In this study significant correlation found between CAC and vascular diseases but there was no significant correlation found between smoking and CAC. Table-1 shows age and gender distribution of patient in that highest number of patient both male and female in between 20 to 49 year of age group. Table-2 shows in our study mean age of female patient was 35.9 years and 35.70 from male patient and mean age of all patients was 35.85 years. Chart-1 shows gender distribution pattern and chart 2 shows age distribution. Chart-3 shows Relationship between Hypertension, Diabetes mellitus, Smokers and CAC. Table-3 shows out of total 892 male patients, 8 patient having CAC and no single female patient had CAC. Table-4 shows all the patients those having CAC were male. Table-5 shows Relationship between Hypertension, Diabetes mellitus, Smokers and CAC. In our study Table-5 reveal 3.1 % hypertensive patient having CAC and 0.24 % non hypertensive patients having CAC. On the other hand 4.25 % diabetes mellitus patient having CAC and 0.30 % patient of CAC found in without Diabetes mellitus and 0.46 % Patient with CAC found in total smokers in our study.



**Chart-1: Gender Distribution of Study Population**

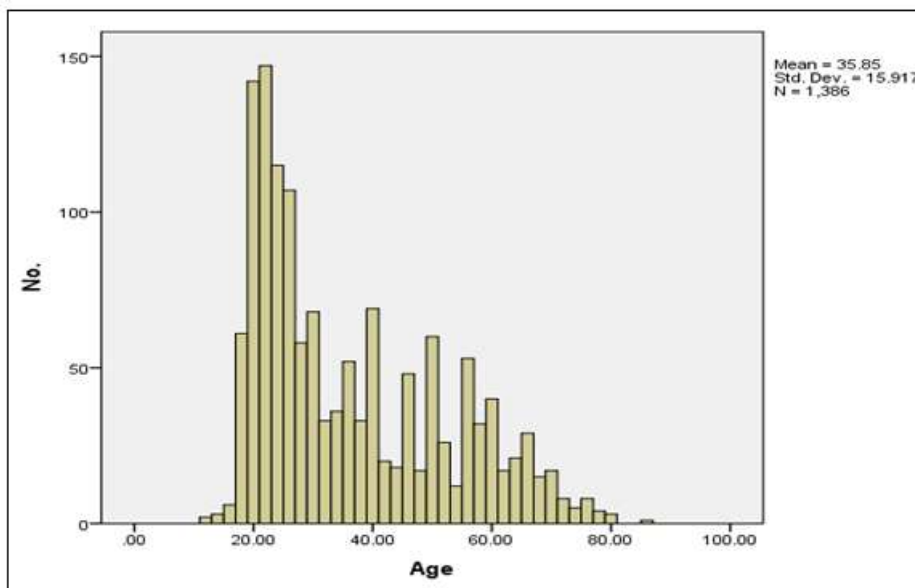


Chart-2: Age Distribution of Study Population

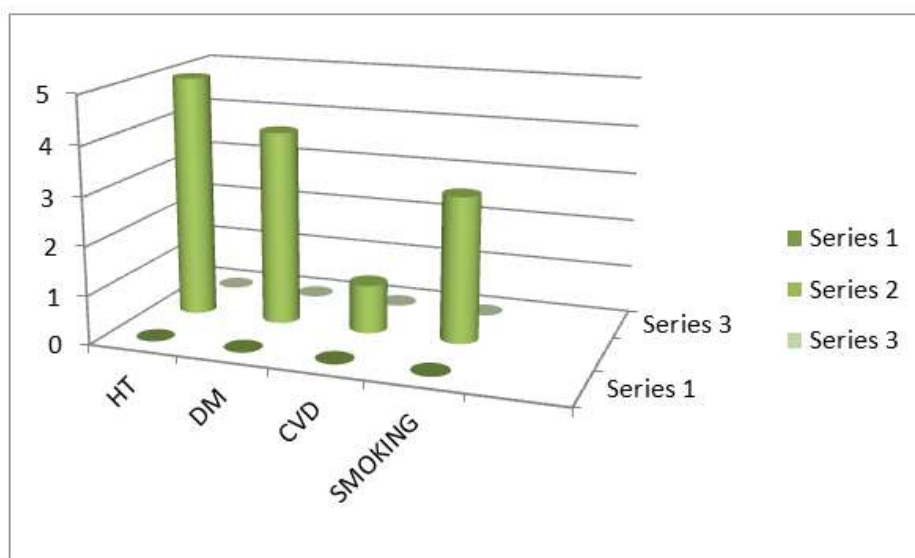


Chart-3: Relationship between Hypertension, Diabetes mellitus, Smokers and CAC

Table-1: Distribution of study participants according to age & gender

Age	Male		Female		Total	
	No.	%	No.	%	No.	%
< 20	82	5.92	37	2.67	119	8.59
20-49	578	41.70	344	24.82	922	66.52
50-69	195	14.07	106	7.65	301	21.72
≥70	37	2.67	7	0.51	44	3.17
<b>Total</b>	<b>892</b>	<b>64.36</b>	<b>494</b>	<b>35.64</b>	<b>1386</b>	<b>100.00</b>

Table-2: Mean age of study population

sex	N	Mean	Std. Deviation	Minimum	Maximum	Range
Male	892	35.9316	16.75213	12.00	85.00	73.00
Female	494	35.7085	14.30060	13.00	80.00	67.00
<b>Total</b>	<b>1386</b>	<b>35.8521</b>	<b>15.91681</b>	<b>12.00</b>	<b>85.00</b>	<b>73.00</b>

**Table-3: CAC in Male and Female**

CAC ( RT )	Male		Female		Total	
No	884	99.10	494	100.00	1378	99.42
YES	8	0.90	0	0.00	8	0.58
Total	892	100.00	494	100.00	1386	100.00

**Table-4: Side wise finding of CAC**

	Male	Female	Total
<b>Rt side</b>	3	0	3
<b>Lt side</b>	3	0	3
<b>Both side</b>	2	0	2
			8

**Table-5: Relationship between Hypertension, Diabetes mellitus, Smokers and CAC**

	Presence of CAC	Absence of CAC	Total
Presence of history of Hypertension	5 ( 3.1 % )	153 (96.83%)	158
Absence of a history of Hypertension	3 (0.24%)	1225 (99.75%)	1228
Presence of a history of Diabetes Mellitus	4 (4.25%)	90 (95.74%)	94
Absence of a history of Diabetes Mellitus	4(0.30%)	1288 (99.69%)	1292
Presence of history of Smoking	3 (0.46%)	649 (99.53%)	652
Absence of history of Smoking	4(0.54%)	733 (99.45%)	737
Presence of other CVD	1 (3.22%)	29(93.54%)	31

**DISCUSSION**

Panoramic radiographs, (PRs) commonly used in dentistry, may have a diagnostic function in identifying many anatomic variations and pathologies that are related to underlying systemic disease [1]. This imaging system however also has the capability to simultaneously demonstrate a portion of the neck and display atheromas (calcifications in the carotid artery) which are an indication of both local and generalized (systemic) atherosclerosis [2].

It consists of a radiographic method that uses low doses of radiation has low cost and ease less time consuming and has technical simplicity that makes it extremely useful in identifying anatomic structures of the head and neck [3].

In our study one of the important objective is to evaluate the incidence of carotid artery calcification (CAC) in PRs and its clinical importance. Atheromatous plaques (CAC) even in cases of partial calcifications can be observed in panoramic radiographs, which in turn represent one of the imaging examination most requested in dentistry at present [4].

In radiographs, the image of the atheromas can be presented as one or more irregular radiopacities with varied sizes, localized approximately 2.5 cm posterior and inferior to the mandibular angle, adjacent to the space between vertebrae C3 and C4, unior bilaterally and in the absolute majority of cases, is comprised within the area of coverage of the panoramic radiographic cut [5].

Patients with CAC on panoramic radiographs are more likely to have peripheral artery diseases. The

detection of CAC may be a useful marker and predictor for (PAD) peripheral artery diseases. Due to the presence of significant relationships between calcifications and some recognized risk factors it was speculated that detection of carotid artery calcifications on panoramic radiographs might be an important factor for identification and treatment of patients at risk of vascular events and an important step in the prevention of major life-threatening events such as ischemic stroke and myocardial infarction [13].

In our study CACs were identified on the PRs of 8 patients. (0.6 %) of the individuals in the study group sample of OPG all male most of them (5 patients) were more than 50 yrs. Similar outcome was seen in some previous studies and some studies shows either more or less incidence [14].

In our study significant statistical correlation found between CVD and PAD and associated risk factor with CAC on panoramic radiographs. Almost all previous studies showed significant correlation among above factors. No significant relationship was found between smoking and incidence of carotid artery calcification in the present study.

Several previous studies show comparison of incidence of CAC in smokers and non-smokers. Significant differences were found between the incidence of carotid artery calcifications and history of hypertension and diabetes in our study (P < 0.04) [15, 16].

Some researchers also showed significant differences above same factors in their studies. In our study equal prevalent found both right and left side and

all CAC found in male only, some previous studies shows significant difference whereas others non-significant relationship, several studies reported more in females than males.

## CONCLUSION

In this study, 2000 panoramic radiographs were surveyed and used as a diagnostic tool to evaluate any underlying local and systemic diseases. One of the focus of our study was to detect Carotid artery calcification.

In this current study we concluded that panoramic radiographs had a moderate accuracy in detection of carotid artery calcification, but dental clinicians should bear in mind that panoramic radiography has a low sensitivity in the detection of carotid artery calcification.

It is not advisable to use panoramic radiography as a routine screening tool for detecting carotid artery calcification, although carotid artery calcification found on panoramic radiograph taken for dental treatment is useful for detecting asymptomatic patients at risk of cardiovascular disease and referring such patients to physicians for further diagnosis and treatment.

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