Incidence of mandibular nutrient canals in a hypertensive and diabetic population: A prospective cross-sectional radiographic study

Vibhuti Kaul[1,*], Rudra Kaul[2], Rimsha Ahmed[3], Satvinder Singh[4], Muneet Kapoor[5]

[1]Registrar, [2]Lecturer, [3]Senior Lecturer, [4]HOD, [5]PG Scholar, [1,4]Dept. of Oral Medicine & Radiology, [2]Dept. of Conservative Dentisry and Endodontics, [3]Dept. of Prosthodontics and Crown & Bridge, [5]Dept. of Oral and Maxillofacial Surgery, [1,2,4]Indira Gandhi Dental Medical College and Hospital, Jammu, [3]Mithila Minority Dental College and Hospital, Darbanga, Bihar, [5]Government Dental College, Srinagar, Jammu and Kashmir, India

***Corresponding Author:**
Email: kaulvibhuti@yahoo.com

Abstract

Introduction: To evaluate a possible correlation of presence of nutrient canals on radiography in hypertensive and diabetic population as compared to the normal population and whether they can be used as a diagnostic marker for these conditions.

Materials and Methods: 360 IOPARSs of the mandibular anterior region were obtained from 120 age and sex-matched subjects without any systemic diseases (Group-I, control group), 120 hypertensive patients (Group-II), 120 diabetic patients (Group III). The radiographs were assessed by two interpreters for the presence or absence of nutrient canals.

Statistical Analysis: The data was tabulated and analyzed with Statistical package for the social sciences (SPSS 20.0). χ^2-square test was done and the statistical significance was set at $P \leq 0.05$.

Results: 225 out of 360 patients showed the presence of nutrient canals whereas 135 patients didn′t have nutrient canals. In Group I (control group), 69 patients showed NCs i.e. 57.5%. In Group II (Hypertensive group) showed NCs in 76 patients (63.3%) while 81 patients (67.5%) showed NCs in Group III. The differences were not statistically significant.

Conclusion: Although the results showed a positive correlation between appearance of nutrient canals on the radiograph and the conditions, the difference was not found to be statistically significant. Therefore, it can be concluded that NCs cannot be solely relied upon as a diagnostic marker for the detection of these diseases. However, their role as a possible diagnostic aid in the future cannot be completely ruled out yet.

Keywords: Nutrient canals, Diagnostic marker, Diagnostic radiology, Hypertension, Diabetes mellitus, Bisecting angle technique.

Introduction

Radiographs constitute an essential part of the diagnostic work-up. Dentistry is no exception to this rule, with dental radiology being inseparable from dental treatment. Dental radiographs are most commonly prescribed for dental caries, their sequelae as well as periodontal disease. Besides these local conditions, the oral cavity is said to manifest 'tell-tale' signs of various systemic conditions, the same is reflected in the radiographs as well. One such finding is said to be the presence of 'Nutrient Canals' (NC).

Nutrient canals are the spaces in the bone and are considered to be the channels that contain blood vessels.[1] They are also known as interdental canals, perforating canals, circulating canals or vascular channels.[2] Said to contain inter-dental and inter-radicular blood and lymph vessels as well as nerves,[3-5] nutrient canals were classified by Lovette[6] in 1948 into 3 categories on the basis of their roentgenographic appearance (width, length, course etc). In 1976, Patel and Wuehrmann[7] classified NC as prominent and discernible subjectively on the basis of distinctness and darkness instead of width. Possibly a variant of normal anatomy, the occurrence of NC have been attributed to systemic conditions such as diabetes, hypertension, rickets, coarctation of aorta etc.[1,2]

Fuelling further curiosity regarding the various hypotheses, our study was an investigation into the possible correlation of incidence of NCs with hypertension and diabetes.

Materials and Methods

This prospective, cross-sectional, radiographic hospital-based study was conducted in the Department of Oral Medicine and Radiology, Indira Gandhi Government Dental College, Jammu in August 2017. Patients reporting with a medical history of having diabetes and hypertension were considered for the study. 120 patients with a medical history of hypertension [Group II] and 120 subjects with medical history of diabetes mellitus [Group III] in the age group of 30-75 years were included in the study. 120 age and sex-matched subjects reporting to the radiology department with no relevant medical history were selected randomly as controls. [Group I]

Patient′s blood pressure recording was done using the auscultatory method. Hypertension was confirmed using the classification given by the Joint National Committee on the Detection, Evaluation, and Treatment of High Blood Pressure VII (JNC VII) (2003).[8]

In case of diabetics, blood examination was done for random blood sugar levels. If the values were found to be raised above normal limits, patients were advised to come on nil per os (NPO) on the next day for fasting blood sugar levels to confirm diabetic status.

Written informed consent was then taken from the patients before taking the intra-oral peri-apical radiograph (IOPAR) of the mandibular anterior region. The IOPAR was taken using bisecting angle technique under International council for radiation protection (ICRP) guidelines. Radiographs were taken with Ergon HF X-ray machine with settings of 70 kvP and 8 mA and an exposure time of 0.7 s and size 2 periapical film was used. The film was then processed by the manual (visual) method in a well-equipped dark room which was light-proof. After drying, the radiographs were mounted on a clean X-ray viewer in a room with dimmed lighting and interpreted by two interpreters using a magnifying glass. Nutrient canals were found to appear as linear radiolucencies of varying size, number and prominence. [Fig. 1-3]

Fig. 1: Example 1 of nutrient canals appearing in the mandibular anterior region in relation to the roots of the teeth

Fig. 2: Example 2 of nutrient canals appearing in the mandibular anterior region in relation to the roots of the teeth

Fig. 3: Example 3 of nutrient canals in the edentulous mandibular anterior region

Findings were recorded as presence or absence of NC in a prepared format decided by consensus. The data was tabulated and analysed with Statistical package for the social sciences (SPSS 20.0). χ^2-square test was done and the statistical significance was set at $P \leq 0.05$.

Results

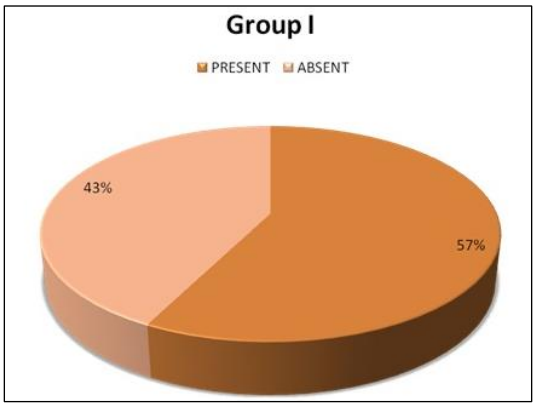

Fig. 4: Group I- Control Group

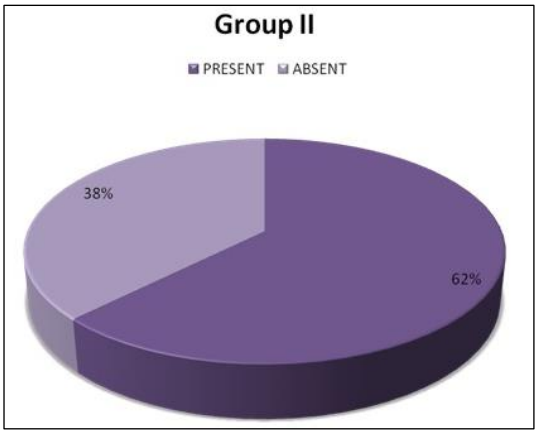

Fig. 5: Group II- Hypertensives

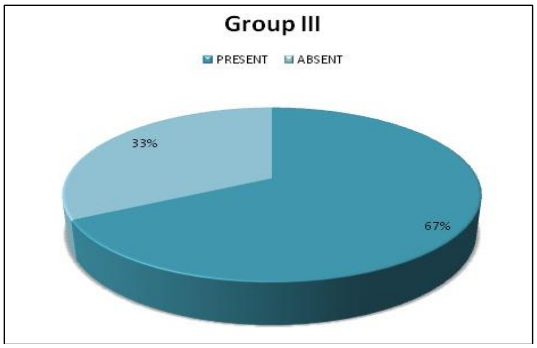

Fig. 6: Group III- Diabetics

A total of 360 patients were screened. Of these, 225 patients exhibited nutrient canals whereas 135 patients didn't have nutrient canals (NCs). 69 patients from Group I [control] showed presence of NCs which accounts to 57.5% prevalence [Fig. 4]. 76 out of 120 hypertensive patients [Group II] showed the presence of NCs i.e. 63.3% prevalence [Fig. 5]. 81 diabetics from Group III showed presence of NCs i.e. 67.5% prevalence [Fig. 6]. Our study also showed a slightly higher prevalence in males where males showed 63.6% prevalence to that of females with 61.6% prevalence.

The age-wise distribution of patients in Groups II and III is shown in Table 1 and 2.

Table 1: Age-wise distribution of patients in Group II

Group II	HTN			
	Number	Present	Absent	% prevalence
31-40	28	18	10	64.3
41-50	28	17	11	60.7
51-60	19	15	4	78.9
61-70	34	20	14	58.8
71-80	11	6	5	54.5
Total	120	76	44	
p value		0.6		

Table 2: Age-wise distribution of patients in Group III

Group III	DM			
	Number	Present	Absent	% prevalence
31-40	30	23	7	76.7
41-50	29	19	10	65.5
51-60	23	17	6	73.9
61-70	31	17	14	54.8
71-80	7	5	2	71.4
Total	120	81	39	67.5
p value		0.413		

Table 3: Overall group-wise distribution of NCs

	Present	Absent	p-value
HTN	76	44	0.427
DM	81	39	0.141
CONTROL	69	51	

Discussion

Nutrient canals were first described by Hirschfield in 1923.[1] Although there may be noticed in any part of the oral cavity, they are more frequently seen in the mandibular anterior region.[9] In 1953, Weinberger attributed the predominance of NC in the anterior mandibular region to the following facts:[5,9,10]

1. Thin alveolar process
2. Horizontal arrangement of trabeculae
3. Decreased bony support of cortical and cancellous bone
4. Comparatively more irritation from calculus and trauma

Both bisectingangle as well as paralleling techniques have been used for the visualization of NCs till date. Some studies did not mention the technique used in their study.[4,5,11] Few authors mentioned having utilized the bisecting angle technique,[12-14] while Patel and Wuehrmann[7] reported to have employed the paralleling technique for visualizing NCs. Bisecting angle technique was selected this study for taking the radiographs to bring out the better appearance of nutrient canals which is in concurrence with other authors and convenience in a government setting.

Variable results regarding the distribution of the nutrient canals with respect to sex have been found in different studies. Most studies quote a female preponderance;[15-17] while one study reported increased incidence in males.[12] No correlation between the existence of nutrient canals and sex of the patients was however reported in one study.[7] No hypothesis has been suggested for the increased incidence in a particular sex by any of the studies. Our study showed a slightly higher prevalence in males where males showed 63.6% prevalence to that of females with 61.6% prevalence.

Group II (hypertension) and nutrient canals

The occurrence of nutrient canals in hypertensive patients was 63.3% when compared to that of the controls which was 57.5%. The *P* value was found to be 0.427, which was statistically insignificant. This is in concurrence with the results of Patel and Wuehrmann[7] where the prevalence of nutrient canals in hypertensive patients was 60% and Mani et al[1] who reported an incidence of 64% in hypertensives. However, the studies done by Patni, *et al*.[5] and Bilge, *et al*.[15] reported a higher prevalence of nutrient canals in hypertensive patients at 70.4% and 79.16% respectively. This could be possibly due to the larger sample size and difference in sampling procedures followed in their study. The study by Patsakas and Donta[12] in 1990 showed a lower prevalence than our study at 55% but higher than non-hypertensives (41.66%) nevertheless. In a 2003 study conducted by

Yilmaz et al,[18] no correlation was found between hypertension and nutrient canals.

Etiopathogenesis has been hypothesized by Haslett, *et al*.[14] in 2002. They said that the chief effects of hypertension are the dilatation of arterioles caused by hypertension followed by hyperplasia and hypertrophy of the vessel wall, and ultimately arteriosclerosis. Subsequent to arteriosclerosis, as narrowing of the vessel lumen takes place, opening up of more collaterals might be triggered in order to compensate for the reduced blood supply. This may be responsible for the increased incidence of nutrient canals in hypertensive patients.

Group III (Diabetes mellitus) and nutrient canals

The occurrence of nutrient canals in hypertensive with diabetes mellitus patients was 67.5% when compared to the control group which was 57.5%. This is somewhat similar to the findings of Mani et al[1] who found a prevalence of 62% in their study. Patel and Wuehrmann[7] reported a 58.4% prevalence in diabetes mellitus patients and Pierrakou and Donta[11] reported a 75.34% prevalence in diabetes mellitus.

Etiopathogenesis for diabetes was in turn hypothesized by Isselbacher, *et al*.[13] They stated that the insulin deficiency in diabetes has a mitogenic action on the endothelium, which leads to formation of collateral vessels. The process of atherosclerosis seen in diabetes mellitus too can lead to narrowing of vessel lumen. This in turn can lead to collateral vessel formation as a compensatory mechanism, which leads to increased incidence of nutrient canals.

There were certain limitations to our study. Firstly the sample size was small. Furthermore, the difference in the results from other studies can be attributed to patient selection. Presence of other conditions such as periodontitis[2,19] among others documented to affect the presence of NCswere not considered as a parameter in our study thus causing a possible bias in the results. Other overlapping systemic conditions were also not documented. The role of possible cofactors therefore needs to be studied further.

Conclusion

Of the 120 patients in Group I, 69 patients exhibited nutrient canals which accounts to 57.5% prevalence, 76 out of 120 patients in Group II, exhibited nutrient canals which account to 63.3% prevalence and 81 out of 120 patients in control group exhibited nutrient canals which account to 67.5% prevalence. Thus diabetics were found to have the highest prevalence of NCs followed by hypertensives and then controls. The difference was not found to be statistically significant. Therefore, it can be concluded that NCs cannot be solely relied upon as a diagnostic marker for the detection of these diseases.

However, documented to be observed in variety of conditions-normals as well as pathologic, it would not be unwise to establish facts available about nutrient canals to enable the clinician to interpret their presence as a valid diagnostic marker for some specific systemic diseases in the future. Further studies must be conducted with larger cohorts to confirm the association with the said conditions.

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