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Research Article

EVALUATION OF NUTRIENT CANALS IN PERIODONTAL DISEASE, HYPERTENSION AND DIABETES MELLITUS: A CASE CONTROL RADIOGRAPHIC STUDY

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Abstract :

Aim: The present study is undertaken primarily to determine if a correlation in the appearance of nutrient canals with periodontitis, hypertension and diabetes exists and to determine whether the presence of nutrient canals can be used as a clue for the detection of periodontitis, hypertensive and diabetic patients.**Patients and Methods**: A total of 400 subjects were selected from the out-patient department comprising of 100 patient with periodontitis, 100 hypertensive patients, 100 diabetic patients and 100 patients without any systemic diseases as control group. Intraoral periapical radiograph of all these patients were taken for evaluation.**Statistical Analysis Used**: Statistical analysis of the data was done using the statistical package for the social sciences (SPSS 15.0) using Chi-square analysis. Differences were considered as significant when $P \leq 0.05$.**Results:** Of all this 400 patients, 208 patients exhibited nutrient canals whereas 192 patients didn't have nutrient canals. Of the 100 patients having periodontitis, 54 patients exhibited nutrient canals which accounts to 54% prevalence, 56 out of 100 patients having hypertension exhibited nutrient canals which account to 56% prevalence, 59 out of 100 patients having diabetes mellitus exhibited nutrient canals which account to 59% prevalence and 35 patients in control group exhibited nutrient canals which account to 35% prevalence.**Conclusion**: As the study showed positive correlation, we conclude same that presence of nutrient canal can be used as an aid to rule out local disease like periodontitis and systemic diseases like hypertension and diabetes mellitus.

KEY WORDS: Nutrient canals, Radiograph, Periodontitis, Diabetes, hypertension

INTRODUCTION

Diagnostic radiography has evolved as an inseparable branch of dentistry in which intraoral radiography is undoubtedly the backbone of dental radiology. It plays a key role in coming to a final diagnosis by complimenting clinical examination. [1, 2, 3]

Dental radiography is used primarily to recognize dental caries, periapical and periodontal diseases and to locate impacted teeth. Though we may be well versed with the normal anatomy, slight variations may highlight unrecognized systemic disorders.[4,5,6,7] The radiographic recognition of disease requires a sound knowledge of the radiographic appearance of normal structures. We can visualize different anatomical landmarks on the intraoral radiographs

Nutrient canal is such an anatomical landmark which one can appreciate in an intraoral periapical radiograph (IOPA). Nutrient canals are the radiolucencies representing the spaces in bone through which blood vessels and nerves travel to supply surrounding structures. They were first described by Hirschfeld in the year 1923 and he called them *interdental channels*. The terminal points of these canals are seen as small nutrient foramina. Kishi (1982) and Patni (1985) observed that nutrient canals were more often seen in the mandible anterior region followed by the mandibular premolar region and the wall of maxillary sinus.[1,2,3, 8] Intraoral periapical dental radiography, despite being two dimensional and limited in size, appears to be the best projection to identify the nutrient canals in the anterior mandible. [8]

Nutrient canals are not seen in radiographs of all patients and as a result, their normalcy is questioned by many investigators. Some consider them normal structures, whereas others have correlated the radiographic appearance of nutrient canals with various pathologic conditions such as periodontal disease, hypertension, diabetes, tuberculosis, rickets, calcium deficiency, disuse atrophy and coarctation of aorta. [5, 6]

Thus, the present study was conducted to evaluate the presence or absence of nutrient canals & number of nutrient canals in normal subjects and to compare them with that in patients with periodontitis, patients with hypertension and patients with diabetes mellitus.

AIMS AND OBJECTIVE

1. To evaluate nutrient canals on intra oral periapical radiographs (IOPA) of mandibular anterior region in normal persons of different ages and both the genders.
2. To evaluate nutrient canals in patients with only periodontitis.
3. To evaluate nutrient canals in patients with hypertension.
4. To evaluate nutrient canals in patients with diabetes mellitus
5. To compare the incidence and number of nutrient canals in normal persons with that in patient having only periodontitis, having hypertension and having diabetes mellitus.
6. To evaluate diagnostic/prognostic value of presence or absence and numbers of nutrient canals in mandibular anterior region on IOPA radiographs in patients with periodontitis, hypertension and diabetes mellitus.

MATERIAL AND METHOD

This is a cross sectional hospital based study conducted in the outpatient Department, Department of Oral Medicine and Radiology. Subjects of the present study consisted of patients who gave a medical history of having diabetes and hypertension and having periodontitis. About 100 subjects with medical history of hypertension, 100 subjects with medical history of diabetes mellitus and 100 patients having periodontitis in the age group of

11‑50 years were included in the study. 100 subjects with no relevant medical history with in this age group were selected randomly as controls among the patients attending radiology department during this period. A detailed history of the patient and thorough clinical examination was done and findings recorded for periodontitis, hypertension and diabetes mellitus. Patient's blood pressure was recorded using a sphygmomanometer and the patients were subjected for blood examination for random blood sugar levels. If the values of the blood sugar were above the normal limits, patients were advised to come on empty stomach on the next day and the patients were subjected for fasting blood sugar evaluation. After the clinical examination and blood investigations, an intraoral periapical radiograph of the mandibular anterior region was taken using paralleling technique under International council for radiation protection (ICRP) guidelines, protecting the patient and the operator.

Result:

Among 400 individuals 184 are male and 216 are female. Mean age of male is 31 and mean age of female is 32. Figure 1 (A to D) showing nutrient canals in case and control group.

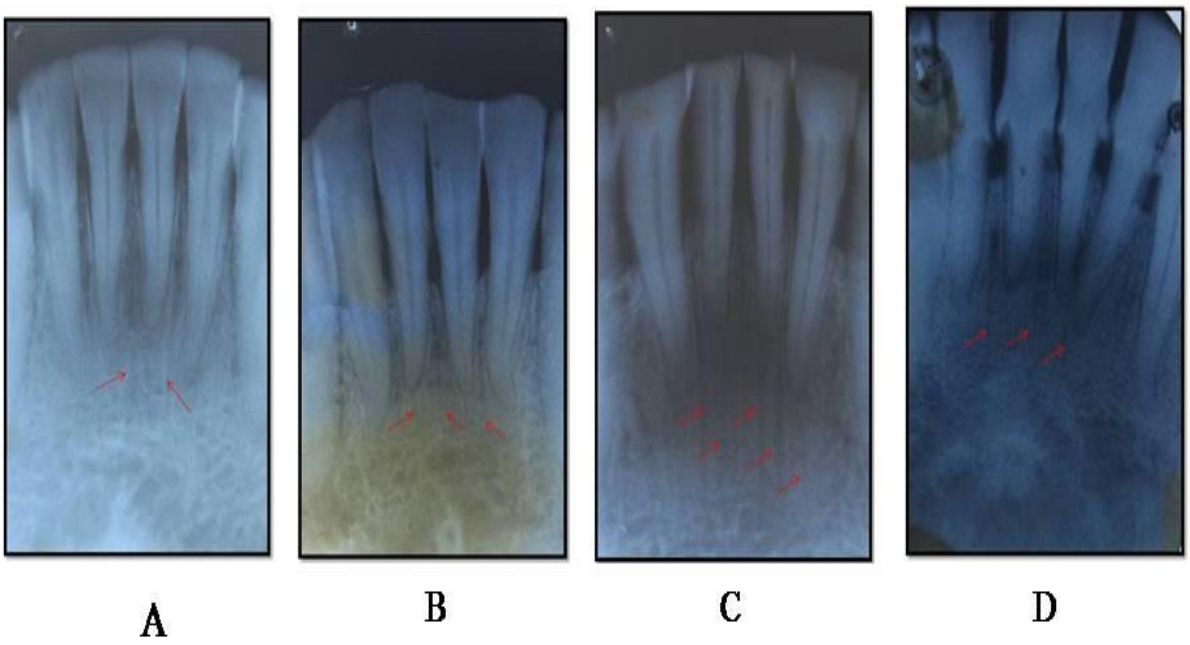

Figure 1 A to D. Intraoral periapical radiograph showing nutrient canals in (A) Normal individual (B) Person having periodontitis (C) Person having hypertension (D) Person having Diabetes

Relationship between age and nutrient canals:

Table I demonstrates presence & prevalence of nutrient canals in different age groups

AGE GROUPS (IN YEARS)	NO. OF PERSON	NO. OF PERSON HAVING NUTRIENT CANALS	SUM OF NUTRIENT CANALS	MEAN OF NUTRIENT CANALS
11-20	8	2 (25%)	2	1
21-30	169	72 (42.6%)	131	1.81
31-40	182	104 (57.14%)	244	2.34
41-50	41	30 (73.17%)	84	2.8
TOTAL	**400**	**208 (53.5%)**	**461**	**2.21**

Chi-Square Value: 17.606 p value: 0.001

Table I demonstrates presence & prevalence of nutrient canals in different age groups. Out of total 400 patients, only 208 (53.5%) were having 461 nutrient canals in intraoral periapical radiograph of mandibular anterior region with mean of 2.21. Out of 8 patients of age group of 11-20 years, 2 (25%) patients were having total of 2 nutrient canals with mean of 1. Out of 169 patients of age group of 21-30 years, 72 (42.60%) patients were having 131 nutrient canals with mean of 1.81. Out of 182 patients of age group of 31-40 years, 104 (57.14%) patients were having 244 nutrient canals with mean of 2.34. Out of 41 patients of age group of 41-50 years, 30 (73.17%) patients were having 84 nutrient canals with mean of 2.8. On comparing presence and abscence of nutrient canals in different age groups Chi-Square value was 17.606 and p value was 0.001 which were found to be statistically significant.

Relationship between gender and nutrient canals:

Table II demonstrates presence & prevalence of nutrient canals in both gender

GENDER	NO. OF PERSON	NO. OF PERSON HAVING NUTRIENT CANALS	SUM OF NUTRIENT CANALS	MEAN OF NUTRIENT CANALS
MALE	184	85 (46.19%)	173	2.03
FEMALE	216	123 (56.94%)	288	2.34
TOTAL	**400**	**208 (53.5%)**	**461**	**2.21**

Chi-Square Value: 4.599 p value: 0.032

Table II demonstrates presence & prevalence of nutrient canals in both gender. Out of 184 male patients, 85 (46.19%) patients were having 173 nutrient canals with mean of 2.03. Out of 216 female patients, 123 (56.94%) patients were having 288 nutrient canals with mean of 2.34. On comparing presence and abscence of nutrient canals in both gender Chi-Square value was 4.599 and p value was 0.032 which were found to be statistically significant.

Prevalence of nutrient canals between case and control group:

Table III demonstrates presence & prevalence of nutrient canals in different diseases				
	NO. OF SUBJECT	**PRESENT OF NUTRIENT CANALS**	**SUM OF NUTRIENT CANALS**	**MEAN OF NUTRIENT CANALS**
NORMAL	100	35 (35%)	45	1.28
PERIODONTITIS	100	54 (54%)	106	1.96
HYPERTENSION	100	56 (56%)	174	3.1
DIABETES	100	59 (59%)	143	2.42
	Chi-Square Value: 0.240 , P value: 0.00887			

Table III demonstrates presence & prevalence of nutrient canals in different diseases. Out of 100 normal controls, 35 (35%) person were having 45 nutrient canals with mean of 1.28. Out of 100 patients of periodontitis, 54 (54%) having 106 nutrient canals with mean of 1.96. Out of 100 patients of hypertension, 56 (56%) having 174 nutrient canals with mean of 3.1. Out of 74 patients of diabetes with periodontitis, 47 (63.51%) having 111 nutrient canals with mean of 2.66. Out of 100 patients of diabetes, 59 (59%) were having 143 nutrient canals with mean of 2.42. On comparing presence of nutrient canals in normal controls, person having only periodontitis, having hypertension, having diabetes Chi-Square value was 0.240 and p value was 0.00887 which were found to be statistically significant.

Relationship between bone loss level and nutrient canals:

Table IV demonstrates presence & prevalence of nutrient canals in only periodontitis patients according to level of bone level				
	PERIODONTITIS			
LEVEL OF BONE LOSS	**No. of person**	**No. of person having nutrient canals**	**Sum of nutrient canals**	**Mean of nutrient canals**
<1/2 of root length	47	16 (34.04%)	29	1.81
>1/2 of root length	53	42 (79.24%)	86	2.04
TOTAL	**100**	**58 (58%)**	**115**	**1.98**
	Chi-Square Value: 20.894 p value: <0.0001			

Table IV demonstrates presence & prevalence of nutrient canals in only periodontitis patients according to level of bone loss. Out of total 100 patients having only

periodontitis, 47 were having bone loss <1/2 of root length of mandibular anterior teeth while 53 patients were having bone loss >1/2 of root length of mandibular anterior teeth. Out of 47 patients of periodontitis having bone loss <1/2 of root length, 16 (34.04%) patients were having 29 nutrient canals with mean of 1.81. Out of 53 patients of periodontitis with bone loss >1/2 of root length, 42 (79.24%) patients were having 86 nutrient canals with mean of 2.04. On comparing presence and abscence of nutrient canals in various groups of periodontitis patients according to bone loss level, Chi-Square value was 20.894 and p value were <0.0001 which were found to be statistically significant.

Table V demonstrates presence & prevalence of nutrient canals in hypertensive patients with different duration of disease

DURATION OF HYPERTENSION (IN YEARS)	**HYPERTENSION**			
	No. of person	**No. of person having nutrient canals**	**Sum of nutrient canals**	**Mean of nutrient canals**
<4	67	35 (52.23%)	93	2.65
4-8	31	19 (61.29%)	57	3
>8	02	02 (100%)	08	4
TOTAL	**100**	**56 (56%)**	**158**	**2.82**
	Chi-Square Value: 1.713 p value: 0.0425			

Table V demonstrates presence & prevalence of nutrient canals in hypertensive patients with different duration of disease.

Out of 100 patients having hypertension, 67 were having duration of <4 years, 31 were having duration of 4-8 years and 02 were having duration of <8 years. Out of total 100 patients having hypertension, 56 (56%) were having 158 nutrient canal with mean of 2.82. Out of 67 patient of hypertension with duration of hypertension <4 year, 35 (52.23%) patients were having 93 nutrient canals with mean of 2.65. Out of 31 patient of hypertension with duration of hypertension 4-8 year, 19 (61.29%) patients having 57 nutrient canals with mean of 3. The 02 patient (100%) of hypertension with duration of hypertension >8 years was having 8 nutrient canals with mean of 8.

On comparing presence and abscence of nutrient canals in hypertensive patients with different duration of disease Chi-Square value was 1.713 and p value was 0.0425 which were found to be statistically significant.

Table VI demonstrates presence & prevalence of nutrient canals in diabetic patients with different duration of disease

DURATION OF DIABETES (IN YEARS)	**DIABETES MELLITUS**			
	No of person	**No. of person having nutrient canals**	**Sum of nutrient canals**	**Mean of nutrient canals**
<3	16	04 (25%)	06	1.5
3-6	76	46 (60.52%)	119	2.58

>6	4	4 (100%)	13	3.25
TOTAL	**100**	**54 (54%)**	**138**	**2.55**
	Chi-Square Value: 5.736 p value: 0.057			

Table VII demonstrates presence & prevalence of nutrient canals in diabetic patients with different duration of disease.

Out of 100 patients having diabetes, 16 patients were having duration of <3 years, 76 patients were having duration of 3-6 years and 4 patients were having duration of >6 years. Out of total 100 patients having diabetes, 54 (54%) were having 138 nutrient canal with mean of 2.55. Out of 16 patients of diabetes with duration of diabetes <3 year, 4 (25%) patients were having 6 nutrient canals with mean of 1.5. Out of 76 patient of diabetes with duration of diabetes 3-6 year, 46 (60.52%) patients having 119 nutrient canals with mean of 2.58**.** Out of 4 patient of diabetes with duration of diabetes >6 year, 4 (100%) patients having 13 nutrient canals with mean of 3.25.

On comparing presence and abscence of nutrient canals in diabetic patients with periodontitis with different duration of disease Chi-Square value was 5.736 and p value was 0.057 which were found to be statistically significant.

DISCUSSION

Nutrient canals are frequently observed in the dental periapical radiographs, and they are considered to serve as conduits for blood vessels and nerves. Some consider them as normal structures, whereas others have correlated the radiographic appearance of nutrient canals with diseases such as hypertension, diabetes, periodontitis etc.[9] The present study was conducted to evaluate the presence or absence of nutrient canals & number of nutrient canals in normal subjects and to compare them with that in patients with only periodontal disease (no systemic diseases like hypertension/diabetes); patients with hypertension and patients with diabetes mellitus.

There was significant difference in the presence and prevalence of nutrient canals within the various age group.[10] Many studies concluded that there was decreased incidence of nutrient canals in patients above 60 years and 30 years of age group.[10,11] Our study showed increase in presence and prevalence of nutrient canals as age advances. The increase in incidence of nutrient canals may be due to effect of local & systemic diseases which patient encounters as advances.

There had been varied opinion regarding the sex distribution of nutrient canals as expressed by various authors. Patel and Wuehrmann[10] said that there was no correlation between the existence of nutrient canals and sex of the patients. Many studies showed that there was an increased incidence of nutrient canals in the female patients; whereas Patsakas and Donta[12] in their study had reported that the incidence was increased in males. No valid explanation had been provided for the increased incidence in a particular sex in the above mentioned studies. Our study showed a slightly higher prevalence of nutrient canals in females compared to males. Due to effect of hormonal imbalance more chance of local & systemic disease in female that could be reason behind slightly higher prevalence of nutrient canals.

Many radiographic study was done between normal control with various disease entity to compare presence of nutrient canals. Study done by Reddy[13,] Bhandarkar Gowri Pandarinath [14], Govind Singh[9], Sudha Mani[15] concluded that there was increase in presence of nutrient canals in local disease like periodontitis compare to normal controls. C. N. Donta[12] & Govind Singh[9] had noticed that as bone loss advances the presence and frequency of nutrient canals also increase. In our study presence & prevalence of nutrient canals was more in patients with periodontitis compare to normal controls & presence and prevalence of nutrient canals was also increase as severity of bone loss advances. The incidence of nutrient canals in patient with periodontal disease is increased as a result of increased bone density caused due to sclerotic change in trabecular bone & compensatory defence mechanism which leads to increase vascularity in local area.[16]

Study done by V.M. Patni[11], C N Donta[12], ED Pierrakou[17], AB Yilmaz[18], Prashanth P Jaju[19], Reddy[13], Sudha Mani[15] concluded that there was increase in presence of nutrient canals in systemic disease like hypertension, diabetes compare to normal controls. In our study presence & prevalence of nutrient canals was more in patients with hypertension or diabetes compare to normal controls. Haslett et al in 2002 said that the principal effects of hypertension are dilatation of arterioles, hypertrophy and hyperplasia of the vessel wall and arteriosclerosis. In arteriosclerosis, along with thickening of the arterial wall, there is narrowing of the lumen, which may lead to the opening of more collateral, or both of these changes may be responsible for the increased incidence of nutrient canals in hypertensive patients.[11] According to Isselbacher et al the deficiency of insulin has the mitogenic action on the endothelial cells, which would lead to collateral vessel formation. In diabetes mellitus also the process of atherosclerosis can be seen leading to narrowing of blood vessel lumen. So we could expect collateral vessel formation as a compensatory mechanism, which leads to increased incidence of nutrient canals in hypertensive or diabetic patient.[15]

Study done by Reddy[13], Sudha Mani[15] had noticed that as duration of hypertension & diabetes increases, presence of nutrient canals also increases. Our study also show the same result.

CONCLUSION:

The present study was undertaken to determine the presence and prevalence of radiographic appearance of nutrient canals in intraoral periapical radiograph of mandibular anterior region in normal controls, patients having periodontitis, hypertension, diabetes.

Based on the present study following result can be summarized:

- Probability of presence and numbers of nutrient canals increased as age advances
- Probability of presence and numbers of nutrient canals were found to be more in females compared to males.
- Probability of presence and numbers of nutrient canals was found more in person having local disease like periodontitis or systemic diseases like hypertension and diabetes compared to normal controls.
- Probability of presence and numbers of nutrient canals was increased as severity of periodontitis increased.
- Probability of presence and numbers of nutrient canals was increased as duration of hypertension and diabetes increases.

As IOPA (intraoral periapical) radiographs are frequently advised by dentist it is important to identify nutrient canals in routine practice as they serve as a diagnostic marker of local disease like periodontitis & diagnostic predictors of various systemic diseases, such as hypertension & diabetes.

However, further studies should be conducted with large sample size to confirm the co-relation between nutrient canals and periodontitis, hypertension & diabetes.

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