Incidence of nutrient canals in hypertensive patients: A radiographic study

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Abstract

Objectives: To determine if any correlation exists in the presence of nutrient canals in hypertensive patients and nonhypertensive patients, to compare the incidence of nutrient canals in different age groups, and also to compare the incidence of nutrient canals between dentulous and edentulous patients. Materials and Methods: This study was carried out on patients, who were divided into a control group comprising of healthy individuals, without history of hypertension and a study group of patients with the history of hypertension. The necessary information like age of the patient, presence or absence of hypertension, its duration, and blood pressure were recorded. An intraoral periapical radiograph of lower anterior region was made using bisecting angle technique and was interpreted. The presence or absence of nutrient canals, bone loss, and the levels of bone loss were recorded. The results so obtained were subjected to statistical analysis. Results: We found that the incidence of nutrient canals was statistically higher in the study group (55.2%) as compared to the control group (36.2%). The incidence of nutrient canals was also found to be increased with, the age till 60 years, amount of alveolar bone loss and in edentulous patients. Conclusion: Hypertension being one of the most commonly encountered medical problems in dental practice and many cases being undiagnosed, the presence of nutrient canal though not entirely indicative of hypertension, should increase the suspicion of the condition to be investigated further.

Key words: Bisecting angle, blood pressure, hypertension, nutrient canals

INTRODUCTION

Nutrient canals are the radioluencies representing the spaces in bone through which blood vessels and nerves travel to supply surrounding structures. They were first described by Hirschfeld¹ in the year 1923 and called them interdental channels. The terminal points of these canals are seen as small nutrient foramina. They appear most frequently on the intraoral periapical radiograph (IOPAR) of the mandibular anterior region, followed by the mandibular premolar region and the wall of maxillary sinus. 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.²

Some consider them as 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.³⁻⁵ The present study was undertaken to determine if a correlation in the appearance of nutrient canals with hypertension exists and to determine whether the presence of nutrient canals can be used as a an evidence for the detection of hypertensive patients.

MATERIALS AND METHODS

After obtaining ethical committee clearance from the institutional review board, 2989 known hypertensive and
normal healthy individuals ranging from 10 to 70 years of age, visiting the Department of Oral Medicine and Radiology were included in this study. Patients with history of systemic disorders like diabetes, tuberculosis, coarctation of aorta, rickets, and other bone disorders, smokers, and any patients with periapical lesions were excluded.

Medical history of the patients was taken to include them into control and study group. In a known hypertensive patient, duration of the hypertension was recorded; blood pressure was determined by auscultatory method in sitting posture and recorded in the proforma. Later on IOPAR of lower anterior region was made using New Life Radiology S.R.L. Via Latina 17 10095 Grugliasco (TO) Italy intraoral X ray machine with an exposure parameters of 70 kVp and 10 mAs. The film was exposed using bisecting angle technique with the exposure time of 0.6 and 0.5 s for the dentulous and edentulous patients, respectively.

Radiographs were processed in automatic film processor (Periomat) and mounted on a viewer. The radiographs [Figure 1] were interpreted using a magnifying lens. The presence of bone loss was recorded as alveolar bone loss upto 1/3rd, 2/3rd, and beyond 2/3rd of root length and placed under poor periodontal status category. Radiographs of patients without any bone loss were placed under good periodontal status category. Radiographs of patients with missing lower anterior teeth were placed under edentulous category. Presence or absence of nutrient canals, their number, and location were recorded in a proforma in a sequential manner. Study group included 1440 cases of known hypertensive and these patients were further subdivided into:

- Group 1: 574 hypertensive patients without any evidence of alveolar bone loss in the periapical radiographs of lower anterior region
- Group 2: 655 hypertensive patients with bone loss
- Group 3: 211 hypertensive edentulous patients.

Control group included 1549 cases of known nonhypertensive and these patients were further subdivided into:

- Group 1: 813 healthy individuals without any evidence of bone loss in the radiograph of lower anterior region
- Group 2: 632 healthy individuals with bone loss
- Group 3: 104 healthy edentulous patients.

**Statistical methods**

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on mean ± standard deviation (min-max) and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance. Chi-square test has been used to find the significance of incidence of nutrient canals in hypertensive and nonhypertensive and the binomial probability distribution has been used to find the significance of incidence of nutrient canals according to study features. A total of 95% confidence interval has been computed in the present study.

**RESULTS**

A comparative study consisting of 1440 hypertensive patients in study group and 1549 healthy individuals in control group was undertaken to study the incidence of nutrient canals in each group and assess the relationship with periodontal status and epidemiological correlation.

Out of 2989 patients, 1354 (45.3%) patients showed the presence of nutrient canals. In the study group, 794 (55.2%) patients showed the presence of nutrient canals and in the control group, 560 (36.2%) patients showed the presence of nutrient canals. The incidence of nutrient canals was 2.17 times more in study group when compared to control group with a significant \( P \) value of 0.001 [Table 1].

In the study, the incidence of nutrient canals was studied in different age groups. In 10-20 years category, all 60 patients belonged to control group and 14 (23.3%) of them had nutrient canals. In 21-30 years category, two patients belonged to study group and none of them had

| Table 1: Comparing the incidence of nutrient canals in the study and control group |
|-----------------------------------|----------|----------|
| Incidence of nutrient canals     | Hypertensive | Non-hypertensive |
| No.     | %        | No.     | %        |
| Present | 794      | 55.2    | 560      | 36.2    |
| Absent  | 646      | 44.8    | 989      | 63.8    |
| Total   | 1440     | 100.0   | 1549     | 100.0   |

\( \chi^2 = 108.566, P < 0.001 \)
nutrient canals, 190 belonged to control group, 42 (22.1%) had nutrient canals. In 31-40 years category, 191 belonged to study group and 537 belonged to control group, among them 50 (26.2%) and 168 (31.2%) in study and control group, respectively, had nutrient canals. In 41-50 years category, 392 and 415 belonged to study and control group, respectively, among them 251 (63.9%) in the study group and 166 (39.9%) in the control group showed the incidence of nutrient canals. In the 51-60 years category among 472 in the study group 302 (63.7%) and among 229 in the control group 120 (52.4%) showed the incidence of nutrient canals. In the 61-70 years category among 383 patients in the study group, 191 (49.9%) and among 118 patients in the control group, 49 (41.5%) showed the incidence of nutrient canals. [Table 2 and Figure 2].

Out of 1229 patients in the study group, 180 (31.4%) patients without bone loss and 494 (75.4%) patients with bone loss had nutrient canals, out of 1445 patients in control group, 127 (15.6%) and 378 (59.8%) patients without and with bone loss, respectively, had nutrient canals [Table 3 and Figure 3].

Out of 1387 patients without bone loss, 307 (22.1%) had nutrient canals. Among 520 patients with bone loss up to 1/3rd root length, 230 (44.2%) had nutrient canals. Among 490 and 277 patients with bone loss up to 2/3rd and more than 2/3rd root length respectively, 338 (68.9%) and 210 (75.8%) respectively had nutrient canals. [Table 4 and Figure 4].

Severity of hypertension was categorized as given by British Hypertension Society depending on systemic and diastolic blood pressure. Among 230 patients with mild hypertension, 128 (55.7%) had nutrient canals. Out of 140 patients with moderate hypertension, 81 (57.9%) had nutrient canals and out of 48 patients with severe hypertension, 28 (58.3%) had nutrient canals [Table 5 and Figure 5].

Among 422 hypertensive suffering from 1 to 3 years, 260 (61.6%) patients had nutrient canals. Among 564 suffering from 4 to 6 years, 332 had nutrient canals. Out

![Figure 2: Graph 1: Incidence of nutrient canals in different age groups](image1)

![Figure 3: Graph 2: Incidence of nutrient canals based on periodontal status in the study](image2)

### Table 2: Incidence of nutrient canals in different age groups

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>No. of patients in study group</th>
<th>No. of patients with nutrient canals</th>
<th>%</th>
<th>P value</th>
<th>No. of patients in control group</th>
<th>No. of patients with nutrient canals</th>
<th>%</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-20</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
<td>-</td>
<td>60</td>
<td>14</td>
<td>23.3</td>
<td>0.039*</td>
</tr>
<tr>
<td>21-30</td>
<td>2</td>
<td>0</td>
<td>0.0</td>
<td>-</td>
<td>190</td>
<td>42</td>
<td>22.1</td>
<td>0.001**</td>
</tr>
<tr>
<td>31-40</td>
<td>191</td>
<td>50</td>
<td>26.2</td>
<td>&lt;0.001**</td>
<td>537</td>
<td>168</td>
<td>31.2</td>
<td>0.018*</td>
</tr>
<tr>
<td>41-50</td>
<td>392</td>
<td>251</td>
<td>63.9</td>
<td>0.005**</td>
<td>415</td>
<td>166</td>
<td>39.9</td>
<td>0.107</td>
</tr>
<tr>
<td>51-60</td>
<td>472</td>
<td>302</td>
<td>63.7</td>
<td>0.002**</td>
<td>229</td>
<td>120</td>
<td>52.4</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>61-70</td>
<td>383</td>
<td>191</td>
<td>49.9</td>
<td>0.041*</td>
<td>118</td>
<td>49</td>
<td>41.5</td>
<td>0.220</td>
</tr>
<tr>
<td>Total</td>
<td>1440</td>
<td>794</td>
<td>55.2</td>
<td>-</td>
<td>1549</td>
<td>559</td>
<td>36.2</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 3: Incidence of nutrient canals based on periodontal status in the study

<table>
<thead>
<tr>
<th>Periodontal status</th>
<th>Study group</th>
<th>%</th>
<th>P value</th>
<th>Control group</th>
<th>%</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>574</td>
<td>180</td>
<td>31.4</td>
<td>813</td>
<td>127</td>
<td>15.6</td>
</tr>
<tr>
<td>Poor</td>
<td>655</td>
<td>494</td>
<td>75.4</td>
<td>632</td>
<td>378</td>
<td>59.8</td>
</tr>
<tr>
<td>Total</td>
<td>1229</td>
<td>674</td>
<td>34.9</td>
<td>1445</td>
<td>505</td>
<td>34.9</td>
</tr>
</tbody>
</table>

Good-bone loss absent, Bad-bone loss present
of 272 patients suffering from 7 to 9 years, 170 (62.5%) had nutrient canals and out of 182 patients suffering for more than 10 years, 32 (17.6%) had nutrient canals [Table 6 and Figure 6]. Among 315 edentulous patients in the study, 175 (55.5%) had nutrient canals and among 2674 dentulous patients, 1179 (44.1%) had nutrient canals and had no significant \( P \) value [Table 8 and Figure 8].

\section*{DISCUSSION}

The studies on the incidence of nutrient canals in the past have showed varied results ranging from as high as 88\% to as low as 5\%\[6,7\]. In our study, which included 2989 patients, the incidence was 45.3\%. The efforts to study the correlation of the presence of nutrient canals with

\begin{table}[h]
\centering
\caption{Incidence of nutrient canals based on extent of bone loss in the study}
\begin{tabular}{|l|l|l|l|l|}
\hline
\textbf{Extent of bone loss} & \textbf{No. of patients} & \textbf{No. of patients with nutrient canals} & \% & \textbf{\( P \) value} \\
\hline
No bone loss & 1387 & 307 & 22.1 & <0.001** \\
Grade 1 & 520 & 230 & 44.2 & 0.095+ \\
Grade 2 & 490 & 338 & 68.9 & <0.001** \\
Grade 3 & 277 & 210 & 75.8 & <0.001** \\
Total & 2674 & 1085 & 40.6 & - \\
\hline
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\caption{Incidence of nutrient canals in study group based on the severity of hypertension}
\begin{tabular}{|l|l|l|l|l|}
\hline
\textbf{Severity of hypertension} & \textbf{No. of patients} & \textbf{No. of patients with nutrient canals} & \% & \textbf{95\% CI} \\
\hline
Mild & 230 & 128 & 55.7 & 49.2-61.9 \\
Moderate & 140 & 81 & 57.9 & 49.6-65.7 \\
Severe & 48 & 28 & 58.3 & 44.3-71.2 \\
\hline
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\caption{Incidence of nutrient canals based on duration of hypertension}
\begin{tabular}{|l|l|l|l|l|}
\hline
\textbf{Duration of hypertension} & \textbf{(10 years and above)} & \textbf{No. of patients} & \textbf{No. of patients with nutrient canals} & \% & \textbf{95\% CI} \\
\hline
1-3 & 422 & 260 & 61.6 & 0.007** \\
4-6 & 564 & 332 & 58.9 & 0.069+ \\
7-9 & 272 & 170 & 62.5 & 0.014* \\
10 years and above & 182 & 32 & 17.6 & <0.001** \\
Total & 1440 & 794 & 55.1 & - \\
\hline
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\caption{Comparing the incidence of nutrient canals in edentulous and dentulous patients}
\begin{tabular}{|l|l|l|l|}
\hline
\textbf{Total no. of patients} & \textbf{No. of patients with nutrient canals} & \% & \textbf{\( P \) value} \\
\hline
Edentulous & 315 & 175 & 55.5 & 0.003** \\
Dentulous & 2674 & 1179 & 44.1 & 0.213 \\
Total & 2989 & 1354 & 45.3 & - \\
\hline
\end{tabular}
\end{table}
hypertension in the various other studies have yielded both positive and negative results. Our study showed the higher incidence of nutrient canals in the study group (55.2%) when compared to control group (36.2%) which was in accordance to the two previous studies reported.\cite{3,5,8,9}

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.\cite{5}

There was also significant difference in the incidence of nutrient canals within the same age group and especially within the age groups of above 40 years of age, but there was decreased incidence in the patients above 60 years and below 30 years of age, which was also observed in previous studies. There were very few patients in the study group below 30 years to compare with the control group. The reason postulated for sudden decrease in incidence of nutrient canals in aged patients is calcification of blood vessels as a process of aging.\cite{3,10}

The incidence of nutrient canals was also correlated with the other factors like presence of periodontal disease, edentulous jaw, severity, and duration of hypertension. The studies in the past have suggested that there is increased incidence of the nutrient canals in the patients with periodontitis.\cite{10,11}

In our study as well, more number of patients with bone loss (54.8%) showed nutrient canals when compared to patients without bone loss (34.9%). This when compared within study and control group, significant number of patients in study group with bone loss (75.4%) showed nutrient canals, while less number of patients with bone loss (59.8%) in control group showed nutrient canals. Similarly, higher number of patients within study group without bone loss (31.4%) showed nutrient canals when compared with control group (15.6%). The incidence of nutrient canals increased as the amount of bone loss increased. Thus, the presence of periodontal disease was a contributory factor for the increased incidence of nutrient canals in hypertensive patients. The incidence of nutrient canals in patients with periodontal disease is increased as a result of increased bone density caused due to sclerotic change in the trabecular bone due to periodontal disease.\cite{11}

In our study, the incidence of nutrient canals in edentulous patients was high when compared to dentulous patients, which was also a finding in a previous study. There was no much difference in the incidence between hypertensive and nonhypertensive edentulous patients. The anatomic structure of the anterior mandible in edentulous patients is quite different from that of dentulous patients, and the higher incidence of nutrient canals in edentulous patients may be associated with resorption of the alveolar bone following tooth loss and the thickness of the remaining alveolar bone.\cite{5,10,11}

In the present study, the incidence of nutrient canals did not show any correlation with the severity and the duration of hypertension, but an interestingly significant reduction in the incidence of nutrient canals was seen in patients suffering from hypertension for more than 10 years. Similar findings were also reported in the previous study except for the fact that the incidence of nutrient canals increased with the duration of hypertension until 10 years. The cause for
this reduction in the incidence may be due to calcification of the blood vessels, which is the terminal stage of arteriosclerosis in patients with long-standing hypertension leading to the disappearance of nutrient canals.\[^{5,11}\]

**REFERENCES**


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