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Correlation Between Age and Gender with The Presence of Anterior Mandibular Nutrient Canals in A Sample of Patients Visited TIU Dental Hospital

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Abstract:
the aim of this study was to determine the prevalence rate of mandibular nutrient canals in a sample of patients who attended TIU dental hospital and to explore whether a link between age and prevalence rate exists and gender predilection can be observed. This retrospective descriptive radiographic study was conducted on OPGs taken in the Department of Radiology and Oral Diagnosis/ Faculty of Dentistry between September 2017 and September 2020. 6631 OPG's were collected and all were examined for this research. It was found that out of total of 3,705 OPGs, about 354 (9.554%) of examined OPGs contained observable nutrient canals while 3,351 (90.445%) of OPGs did not. There was (60%) female, (40%) male split, indicating a slight female gender predilection. The mean age of patients whose OPGs demonstrated nutrient canals was (43) years, ranging between 16 to 80 years, with a nutrient canal mean of (1.406) canals. The highest prevalence rate was in the 1960-1969 age group, closely followed by the 1980-1989 age group. The age group with the least amount of prevalence recorded was the 1940-1949 age group. Most (66.38%) OPGs presented only one nutrient canal. Most people did not present with nutrient canals, only 1 out of 10 patients showing one in their OPGs and most who demonstrated NC in their OPG were middle-aged.

Keywords: *Orthopantogram; Panoramic Radiograph; Implant Safety; Canals; Descriptive Study.*

1. Introduction

Nutrient canals are spaces located in the bone that are considered to be channels through which blood vessels and nerves travel to supply surrounding structures (Teeth, interdental spaces, and gingiva), [1]. They appear as radiolucent dark lines on radiographs [2]. Nutrient canals were frequently seen in patients with alveolar ridges that lack trabecular spaces. 80% of the cases, nutrient canals are seen in the anterior portion of the mandible [3], vertically running from the inferior dental canal to the interdental spaces or directly to the tooth apex of mandibular incisors on both sides of the mandible [4]. The dominance of NCs in the mandibular anterior region is ascribed owing to the horizontal

arrangement of trabeculae, thin alveolar process, reduced bony support of cancellous and cortical bone, and more liable to irritation from calculus and trauma [5].

The most easily recognized nutrient canals are the ones that arise from the mandibular canal which are more prominent with edentulous mandibles [5]. They are derived from the incisive branch of the inferior neurovascular bundle and supply that region till the anterior of the mental foramen [3]. They generally have a vertical direction and vary in size, length, width, and connection to teeth' roots. They either extend downward from the root apex or vertically between the roots of adjacent teeth. These canals can be seen in radiographs of a few patients/individuals [6].

Some investigators [6,7] consider these canals as normal structures, while others relate them to pathologic conditions such as periodontal disease [8,9], hypertension [10], diabetes [11], disuse atrophy [12], and coarctation of the aorta [13]. The potential involvement of the nutrient canals in the local spread of periapical infection hasn't been documented previously [14].

Moreover, it was expressed that the presence of nutrient canals was not a normal finding he explained that their predominance in the lower anterior region is that "this area is comparatively more subjected to irritation from calculus and trauma. Secondly, these teeth do not have bony support, both cancellous and cortical, that exists for other teeth." Hirschfeld first reported nutrient canals, and he called them "interdental channels" [7]. It may be essential to recognize the nutrient canals in the regular radiograph routines as they may serve as markers of different systemic illnesses. It is also worth mentioning that articles suggesting a sex link have not been demonstrated [15].

1.1 Prevalence of Nutrient Canals

According to a study which was done in the Gifu Dental College in Japan, one thousand-five hundred-eighty-six (1586) patients had a complete-mouth radiographic survey, in which they were divided into four groups: Group 1 consisted of 434 patients between the ages of (16 to 79 years); Group 2 had 1,012 students; Group 3 had 100 patients having an orthodontic treatment; Group 4 consisted of edentulous patients, 40 in number with the average of 64 years in age. Radiographs were evaluated to detect the presence or absence of the nutrient canals, the relationship of these canals with age, periodontal diseases, and tooth loss. Results showed that the incidence of the nutrient canals in group 1 and 2 were 54.6% and 2 6.1% respectively, group 3 with the orthodontic treatment only had 1% of incidence, and in 65% for the group 4. The incidence of the nutrient canals was increased with the advancement of age, and it was shown that 86.2% of the patients in group 1 with the incidence of the canals had periodontal diseases. Moreover, with assessing the nutrient canals with tooth loss, 45.6% of the patients with nutrient canals had missing mandibular teeth [3].

1.2 Nutrient Canals and Implants

Nutrient canals carry neurovascular bundles, so injury to those canals has been linked to potential morbidity and sensory disturbances such as postoperative paresthesia. Preoperative assessment is acquired through radiographs and computed tomography (CT) images showing the extent and location of nutrient canals are required to mitigate the risk of morbidity [16]. Moreover, the risk is increased during the bone grafting or placement of intraosseous implants in the anterior region of the mandible. Thus, it is essential to identify nutrient canals to mitigate the above-mentioned complications and risks.

This study aimed to determine the prevalence rate of mandibular nutrient canals in a sample of patients who attended TIU dental hospital and to explore whether a link between age and prevalence rate exists

and gender predilection can be observed. This study used OPGs collected from the Department of Radiology and Oral Diagnosis/ College of Dentistry/ TIU in Erbil, Iraqi Kurdistan.

2. Methodology

This study consists of 6,631 digital OPGs taken between September 2017 and September 2020, provided by and with permission from the Faculty of Dentistry/TIU. OPGs of unacceptable quality, duplicates, not including the full mouth, were excluded from study. It was also decided that OPGs of patients with mixed dentitions would not be suited for this study and were thus not included along with unnamed OPG files, which means that in total, 6,631 OPGs were examined for the study from which 2926 were rejected for the reasons mentioned above and the remaining 3705 were found to be of diagnostic quality.

The panoramic radiographs were taken using this radiographic system: NewTOM – Digital Panoramic X-Ray System Model: PAX400 GIANO. ITALY (2013). Panoramic exams were conducted using NewTOM GIANO "2D" (Verona, Italy) system with a magnifying factor of 1 to 1.1. according to the manufacturer's instructions. The images were recorded digitally with instantaneous time at 60-90 kVp, 1-10mA, and a 9.1 s exposure time. The raw data were reconstructed using NNT Version 10.1 as the key program (Verona, Italy). This device has a Smart Beam Intelligent software that changes milliamperes (mA) and time-based on body size in the Gantry while keeping the kilovoltage (kVp) constant.

This descriptive radiographic study was conducted on OPGs of patients who have visited the Radiology and Oral Department of TIU (Figure 1). The OPGs stored on a mainframe computer connected to the NewTOM Digital Panoramic X-Ray system were retrieved utilizing an external hard drive—afterward, viewed by the team on personal electronic devices all being tuned to maximum brightness and viewed in a dim-lit room. Any differences of opinions on select OPGs were discussed and amended between the team.

2.1 The Study Material

The study material consists of 6631 OPGs. The raw data (Age, gender, prevalence, or absence rate of nutrient canals) were recorded using Microsoft Excel 2016, Microsoft Word 2016, and Google Docs.

2.2 Inclusion Criteria

1. Diagnostic OPG images (Some errors of patient preparation, exposure, positioning, processing, but which do not detract from the diagnostic utility of the radiograph) as specified by the National Radiological Protection Board (United Kingdom), [17].
2. Minimum 15 years of age.
3. Presence of at least one radiolucent line/"Vertical radiolucent streaks" as described by [3].

2.3 Exclusion Criteria

1. Age below 15 years.
2. OPG Images of unacceptable quality (Errors of patient preparation, exposure, positioning, or processing, which render the radiograph diagnostically unacceptable) as defined by a three-point quality scale by the National Radiological Protection Board (United Kingdom).
3. OPG Images of Mixed Dentition.
4. Duplicate of a previous diagnostic image.
5. OPG Images which do not have the full mouth in view.
6. OPG images that are attached to a patient with a unisex name.

7. OPG images which do not have a name attached to the file.

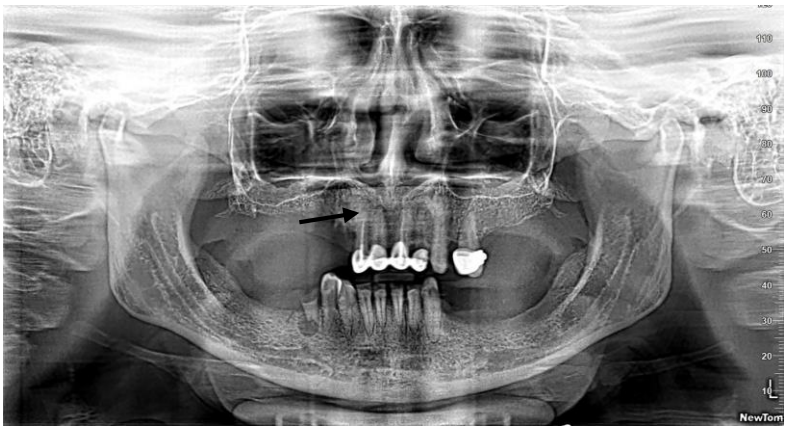

Figure 1: OPG showing nutrient canal.

2.4 Statistical Analysis

Statistical analysis was performed using Microsoft Office Excel 2016 and IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp, Armonk, NY, USA).

3. Results

Out of the 3,705, OPGs evaluated, 354 (9.554%) demonstrated visible nutrient canals, while 3,351 (90.445%) did not, as shown in Figure 2.

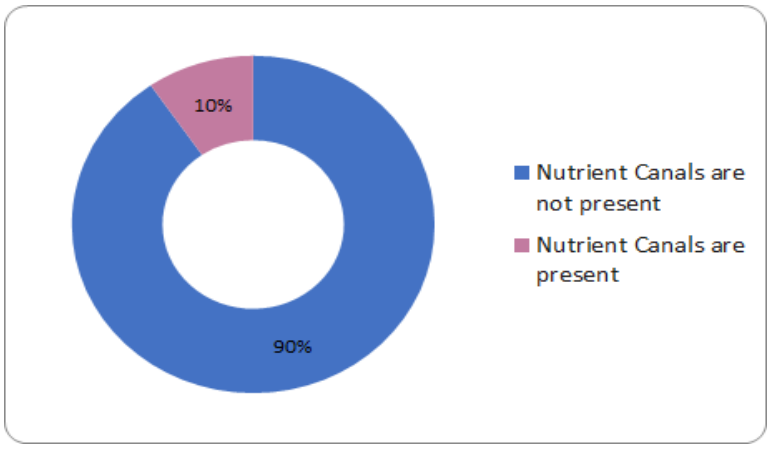

Figure 2: Prevalence of nutrient canal in OPGs included in the study

Out of those 354 OPGs that did demonstrate nutrient canals, 142 were male (40.2%), and 212 (59.8%) were females, as shown in Figure 3. This, in turn, shows that gender predilection exists towards the female gender.

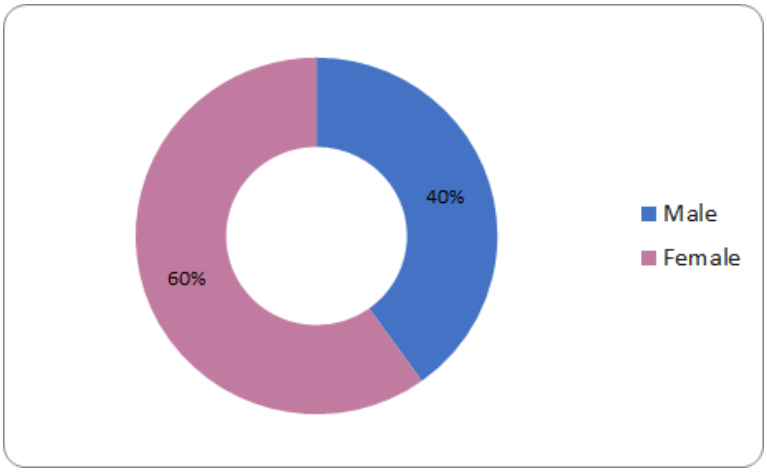

Figure 3: Distribution of gender in OPGs demonstrating Nutrient canals

The average age of participants was 43 years, ranging between 16 to 80 years. As shown in Table 1, the highest rate of prevalence of nutrient canals was recorded in the 51-60 age group with a number of 77 OPGs (21.75%) closely followed by the 31-40 age group, with 75 OPGs (21.19%). The age group with the least amount of prevalence recorded was the 71-80 age group, with 13 OPGs (3.67%). The third-highest rate was found in the 21-30 age group with 70 OPGs (19.77%). Fourth highest was in the 41-50 age group with 65 OPGs (18.36%). Fifth and sixth-highest were in the 61-70 age group with 34 OPGs (9.60%) and the 15-20 age group with 20 OPGs (3.67%) respectively.

Table 1: Demonstrating the prevalence of nutrient canals according to age as of 2020

Prevalence of Nutrient Canals According to Age	Present	Total
71-80	13	3.67%
61-70	34	9.60%
51-60	77	21.75%
41-50	65	18.36%
31-40	75	21.19%
21-30	70	19.77%
15-20	20	5.65%
	354	

Regarding the gender prevalence, for females, the 31-40 age group presents the highest (56) and the 71-80 group the lowest (6) prevalence of nutrient canals retrospectively. For males, the 21-30 age group presents the highest (38) and the 71-80 group the lowest (7) prevalence of nutrient canals retrospectively (Table 2 and Figure 4).

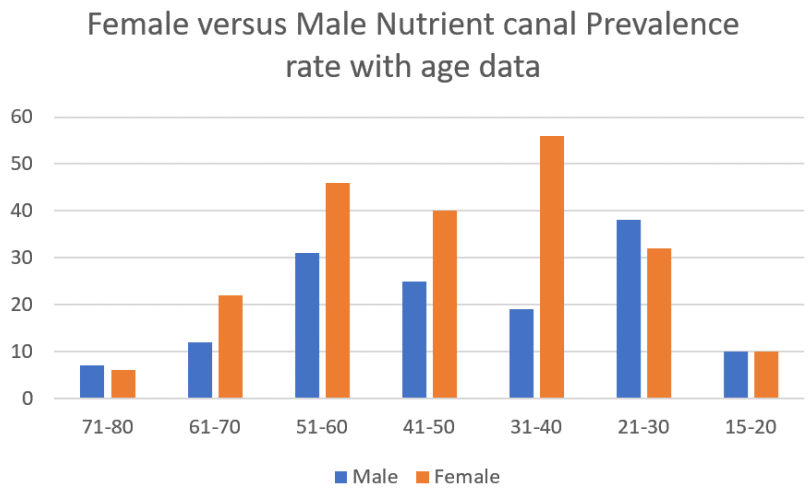

Figure 4: Demonstrating the prevalence of nutrient canals according to age in males and females as of 2020

Table 2: Prevalence of nutrient canals according to male versus female and age distribution.

Prevalence of Nutrient Canals according to age	Male	Female	No. of patients
71-80	7	6	13
61-70	12	22	34
51-60	31	46	77
41-50	25	40	65
31-40	19	56	75
21-30	38	32	70
15-20	10	10	20
	142	212	354

Further investigation reveals that; among the 354 OPGs that demonstrated nutrient canals, most OPGs present with only one nutrient canal (235 OPGs / 66.38%), as shown in Table 3. It is followed by 2 nutrient canals (96 OPGs / 27.12%) and 3 nutrient canals (21 OPGs/5.93%) respectively. Only two patients presented with four nutrient canals (2 OPGs / 0.56%). The mean number of nutrient canals was (1.406) canals.

Table 3: Demonstrating the incidence rate in OPGs with nutrient canals

Prevalence rate of Nutrient canals in a patient	Frequency	% Total
1	235	66.38%
2	96	27.12%
3	21	5.93%
4	2	0.56%
	354	

4. Discussion

The aim of this study was to investigate the prevalence rates of nutrient canals and to investigate whether or not the link between age and prevalence rate and gender predilection exists. Since OPGs offer extensive coverage of the oral cavity, [18] demonstrated that (91%) of OPGs illustrate some form of error, with the most common errors being: Tongue is not placed against the roof of the mouth; palatoglossal air space (32%), Cervical spine slumped (20%), tooth too posterior to bite block/ Head tipped down (17%) and (12%) respectively. (6%) of OPGs were of unacceptable quality and had to be retaken entirely. It is essential to mention that the article never specified what counts as unacceptable quality. Furthermore, [19] found that (66.4%) of OPG demonstrate some form of error and (13.2%) of OPG were classified as unacceptable as per a three-point quality scale by the National Radiological Protection Board (United Kingdom) that the author used.

Furthermore, most of the errors mentioned above affect, to varying degrees, are in the anterior mandible segment, which makes the use of this radiographic method rather tricky for the accurate assessment of nutrient canals. It is also important to mention that because only limited studies exist that examine the prevalence of nutrient canals in OPGs, there are also no (or very limited) articles to which we can directly compare the results from this study to. Thus, only comparisons between articles that use different radiographic diagnostic methods can be made.

The results show that nutrient canals are found in (10%) and absent in (90%) of OPGs, which are close to another study's results with (14%). (6), a study conducted on cadavers using radiographic examination using the bisecting technique. However, these results are in partial disagreement with [4], who used CBCT imaging and found a (16.2%) prevalence rate. The results are in complete conflict with (Kawashima et al., 2015), who found a 94.3% prevalence rate using CT images and [20], who found (92%) prevalence rate and [3], whose findings indicate that they are present in (54.6%) of periapical radiographs.

Concerning the male to female ratio, a (40% / 60%) split was observed, which agrees with [21:22], who demonstrated that nutrient canals occur more commonly in females. The results do, however, contend with [15], who was unable to establish a link to gender and with [3] finding (57.9 percent) of the males and 101 (50.8 percent) of the females showed nutrient canals.

In the context of age, this study could not demonstrate a significant correlation between an increase of prevalence of nutrient canals and age, in agreement with [21]. However, they are in variance of opinion with [3], who suggested that the prevalence of nutrient canals increase with age.

Speaking of age groups, this study found that for females, nutrient canals were most often seen in the 1980-1989 age group and for males in the 1990-1999 age group. These findings are in accord with [21], who also showed that for females, the 1980-1989 age group and for males in the 1990-1999 age group display the most nutrient canals. These results are in a difference of opinion with [3], who denotes that nutrient canal prevalence is highest in the 61+ years age group.

Regarding the mean number of nutrient canals, this study illustrates it to be (1.406) nutrient canals which put it in a variance of opinion with [2], who put the mean number at (2.7). The mean age was shown to be (43 years), in consensus with [3], who also put the mean age at (43 years).

5. Conclusion

This study exhibited the following trends and thus concludes that:

1. Most people did not present with nutrient canals, with usually only 1 out of 10 patients showing one.
2. Nutrient canals were observed slightly more in females.
3. Most patients who showed nutrient canals in their OPG were middle-aged.
4. In most patients OPG, one nutrient canal was observed.
5. Females in their 40s had the highest prevalence of nutrient canals, and males had their highest rate in their 30s.

6. Author's Contribution

"We confirm that the manuscript has been read and approved by all named authors. We also confirm that each author has the same contribution to the paper. We further confirm that the order of authors listed in the manuscript has been approved by all authors."

7. Conflict of Interest

The authors declare no conflict of interest

8. Acknowledgment

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