

REVIEW

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Sexual dimorphism in the incisive canal in humans: A literature review.

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Abstract: Aim: To describe the morphometric characteristics of the maxillary incisor canal (IC) in human beings by gender. Material and method. Descriptive study. A systematic search for articles related to anatomical and topographical variations of the IC by sex and published in the last ten years was performed in the Medline database. Selected publications presented the following criteria: Number of samples and average values, in millimeters (mm), for length, diameter and distance from the IC to the maxillary central incisors (ICM). In addition, author and year of publication were considered. Data were presented using descriptive statistics. Results. Three studies were selected. In men, IC average dimensions were higher in diameter (2.79 ± 0.94 mm v/s 2.43 ± 0.85 mm), length (11.96 ± 2.73 mm v/s 10.39 ± 2.47 mm) and distance from the apex and middle third of the root of the MCI than in women. Conclusion. IC morphometric values were higher in men. It is important to keep in mind IC dimensions vary according to gender when planning surgeries and rehabilitations in this area of the oral cavity.

Keywords: incisive canal, nasopalatine canal, "Maxilla"[Mesh], "Sex Characteristics"[Mesh], "Anatomy"[Mesh].

Dimorfismo sexual del Canal Incisivo en cráneos humanos: Revisión de la literatura.

Resumen: Objetivo. Describir las características morfométricas del canal incisivo del maxilar (CI) según el género en humanos. Material y método. Estudio descriptivo. Se realizó una búsqueda sistemática en la base de datos de MEDLINE, sobre artículos relacionados con las variaciones anatómicas y topográficas del CI entre géneros. Se registró autor, año de publicación, cantidad de muestras y valores promedios en milímetros de la longitud, diámetro y distancia del CI con respecto a los incisivos centrales del maxilar (ICM). Resultados. Se analizaron 3 Artículos. Las dimensiones promedio del CI fueron mayores en los hombres que en las mujeres tanto en el diámetro (2.79 ± 0.94 mm v/s 2.43 ± 0.85 mm), longitud (11.96 ± 2.73 mm v/s 10.39 ± 2.47 mm) y distancia con el ápice y punto medio de la raíz de los ICM. Conclusión. Las características morfométricas del CI fueron mayores en hombres. Se debe tener en cuenta que las dimensiones del CI varían dependiendo del sexo para la planificación de cirugías y rehabilitación en este sector de la cavidad oral.

Palabras clave: nasopalatine canal, sexual dimorphism, humans.

Introduction.

The incisive canal (IC), also known as nasopalatine or anterior palatine duct, is a long slender structure present in the maxillary midline, connecting the oral cavity and the nasal floor cavity^{1,2}. It runs from the floor of the nasal cavity descending laterally on either side of the nasal bone to reach the back of the piriform sinus and joining to come down to the incisive fossa behind the central incisors on the roof of the oral cavity².

According to Tolstunov³, the anterior maxilla has been described as a traumatic area. It is also considered necessary to determine the exact location of the canal previous to surgery of central incisors such as removal of nasopalatine cysts⁴ and mesiodens or when used as anatomical buttress for osseointegrated implants due to its neurovascular content⁵.

Its morphology is conditioned by age and sex of the subject. Liang *et al.*⁶ examined 60 dentate and edentulous jaws concluding that there are no changes in the canal diameter associated to this condition. In

relation to gender, he also found males have a longer and wider canal. However, he also cited in the study: "According to authors like Chandler & Gray⁷, Moss⁹, Jacob⁸ there is scarce documentation about size and morphology of the incisive canal". Hence, literature from the last five years shows contradictions regarding shape and variations of the incisor canal regarding sex of the individual.

Therefore, the objective of this research is to describe sexual dimorphism in the incisive canal in humans by observing measurements, obtained through Computerized Tomography (CT) and Cone Beam Computerized Tomography (CBTC), reported in the literature.

Materials and methods.

Design: Literature review based on a systematic literature search.

Strategy: A search was performed on September 27th, 2013. Articles concerning anatomical and topo-

Database & Search result	Research strategy	Search limit
Medline ("Macro- and micro-anatomical, histological and computed tomography scan characterization of the nasopalatine canal")	(nasopalatine[All Fields] AND ("dental pulp cavity"[MeSH Terms] OR ("dental"[All Fields] AND "pulp"[All Fields] AND "cavity"[All Fields]) OR "dental pulp cavity"[All Fields] OR "canal"[All Fields])) AND ("loattrfull text"[sb] AND "humans"[MeSH Terms])	Nasopalatine canal; human species; 10 years, full text available.
Medline ("Is there a gender difference in anatomic features of incisive canal and maxillary environmental bone?")	(incisive[All Fields] AND ("dental pulp cavity"[MeSH Terms] OR ("dental"[All Fields] AND "pulp"[All Fields] AND "cavity"[All Fields]) OR "dental pulp cavity"[All Fields] OR "canal"[All Fields]) AND ("maxilla"[MeSH Terms] OR "maxilla"[All Fields] OR "maxillary"[All Fields])) AND ("loattrfull text"[sb] AND "2003/10/01"[PDat] : "2013/09/27"[PDat])	Incisive canal maxillary; 10 years, full text available.
Medline ("Nasopalatine Canal Position Relative to the Maxillary Central Incisors: A Cone Beam Computed Tomography Assessment")	(nasopalatine[All Fields] AND ("dental pulp cavity"[MeSH Terms] OR ("dental"[All Fields] AND "pulp"[All Fields] AND "cavity"[All Fields]) OR "dental pulp cavity"[All Fields] OR "canal"[All Fields]) AND position[All Fields]) AND ("loattrfull text"[sb] AND "2003/10/01"[PDat] : "2013/09/27"[PDat] AND "humans"[MeSH Terms])	Incisive canal position; human species; 10 years, full text available.

Table 1. Search Selection Criteria.

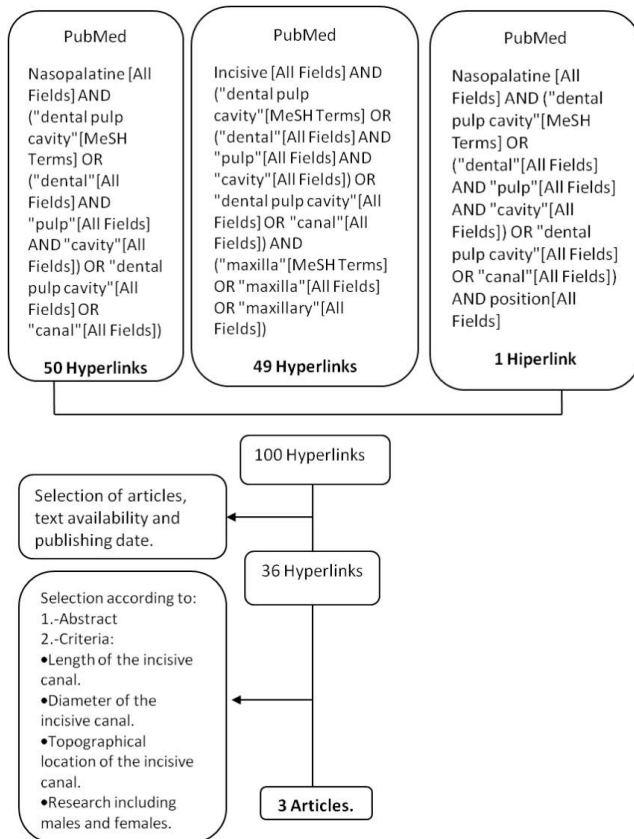


Figure 1. Search Flowchart.

Selection criteria: From retrieved articles, two researchers (AFe, HA) selected topics related to the investigation. Choices were based on: human species, full text available and publication dates in the last ten years. (Figure 1) After a first selection, two researchers (AFr, CS) read the abstracts and collected studies including at least one of the following criteria: length and diameter measures (in millimeters) of the incisive canal using CT or CBCT computer software, topographical location of the IC from the root apex to the central and/or lateral incisor and studies done in patients regardless of sex. Those items including measurements on cadavers, dry skulls or using physical measuring instruments such as rules or manual caliper were excluded. Then, full texts were downloaded and two researchers (RAF, CS) analyzed content and criteria compliance and variable measurements in relation to the IC. In case of disagreement, a third investigator (PA) evaluated the piece in order to arrive at a consensus about the quality of the information. From selected articles, the following data were considered: Author and year of publication, sample sex, instrument used (CT, CBCT), type and value of variable in millimeters (length, diameter and relationship between root apex and central or lateral incisors). A comparative analysis was developed using the aforementioned parameters. Finally, results were discussed and compared using descriptive statistics (mean \pm standard deviation) in Excel Software (Microsoft Corporation®).

graphical variations of the incisive canal published between 2003 and 2013 in the Medline database were sought to attain a comparative analysis by sex. (Table 1)

Results.

The search strategy revealed 100 hyperlinks; but after reading titles and abstracts, only 36 were selected.

Year and Author	Samples	Sample type	Method	Variables	Comments
Xin Liang et al. (2009) ⁶	• 283 Samples -163 Dry skulls. -120 patients CT.	• 120 CT: - 65 Females. - 55 Males.	•Spiral CT scans (Somatom plus S®; Siemens, Erlangen, Germany).	• Length. • Diameter. • Morphological variations.	• Data extracted based in 120 analyzed patients.
Pakawat Chatriyanuyoke et al. (2012) ¹³	• 120 Samples	• 60 Males • 60 Females	• CBCT.	• Proximity of the incisive canal (PIC) to the root of the maxillary central incisors (RICM) in the middle third of root and apex planes.	• Patients with a pathology associated with the central incisors and/or the incisive canal were excluded.
Güliz N. Güncü et al. (2012) ¹⁰	• 933 samples	• 516 Females • 417 Males	• CT.	• Diameter and length of the incisive canal.	• Of all the samples, 725 were dentate and 208 were toothless.

Table 2. Articles selected for the analysis of sexual dimorphism in the incisive canal (IC).

Comparison between distances from the IC to the root of the maxillary central incisor (RMCI) by gender.						Diameter (mm).	Length (mm).
At the middle level of RMCI			At the apex level of RMCI				
Sex	N° Patients	Right	Left	Right	Left	N° Patients	
Male	60	3.45 ± 1.59	3.27 ± 1.50	5.51 ± 1.67	5.42 ± 1.51	417	2.79 ± 0.94 11.96 ± 2.73
Female	60	2.76 ± 1.64	2.70 ± 1.63	4.98 ± 1.42	4.97 ± 1.29	516	2.43 ± 0.85 10.39 ± 2.47

Table 3. Analyzed Measurements Summary.

Finally, the ultimate analysis of the results was completed with only three articles. (Table 1) In these, 1,336 samples, of which 52 % comprised males, were observed. (Table 2)

Main measurements were focused on length, diameter and location according to the upper central incisors. The largest diameter was found in men (average value 2.79 ± 0.94 mm), while the lowest mean value was seen in women (2.43 ± 0.85 mm). Respecting length, higher values were attributed to men (11.96 ± 2.73 mm) while women obtained the lowest ones (10.39 ± 2.47 mm). Concerning topographic location of the incisive canal, the highest mean value for the distance from the canal to the root apex was that of men with 5.51 ± 1.67 mm towards the right incisor and the lowest mean value for the distance from the incisive canal to the middle third of the root was 2.76 ± 1.64 mm towards the right incisor in women. Measurement details are shown in Table 3.

Discussion.

Males have greater length and diameter, as well as more distance between the apex and the middle third of the root of the maxillary central incisors, compared to females.

According to Güncü GN *et al.*¹⁰, the average diameter for males was 2.79 ± 0.94 mm, while that of women was 2.43 ± 0.85 mm.

In the study by Liang X *et al.*⁶, Lordanishivili¹¹, a researcher who found evidence about the direct relationship between variation of the IC average length and sex, was cited. Likewise, Güler¹², who reported males have a significantly larger canal than females, was mentioned.

The above mentioned is evident in the quantitative data obtained in the study by Güncü GN *et al.*¹⁰ where males present an average length of 11.96 ± 2.73 mm and in women a measure of 10.39 ± 2.47 mm.

Referring to topographical location of the IC respecting the root of the maxillary central incisors in Chatriyanuyoke's article¹³, it is observed the distance from the canal to the middle third of the root was of 3.45 ± 1.59 mm towards the right incisor and 3.27 ± 1.50 mm towards left incisor in men. In women, the distance from the canal to the middle third of the root was 2.76 ± 1.64 mm towards the right incisor and 2.70 ± 1.63 to the left incisor. Respecting the distance from the canal to the root apex, men have a distance of 5.51 ± 1.67 mm towards the right incisor and 5.42 ± 1.51 mm towards the left incisor. Similarly, women have a shorter distance (4.98 ± 1.42 mm towards the right incisor and 4.97 ± 1.29 to the left incisor). This can be explained because of the anatomical difference in the jaws of men and women, being larger for men, as Chatriyanuyoke P. lastly mentioned referring to a study by Ferrario VF *et al.*⁴, who endorsed this information in his investigation.

Other factors which may influence anatomical and topographical features of the incisive canal and mentioned by the authors of the studied articles are the following:

- Shape: According to the various shapes this canal may acquire (cylindrical, banana, funnel, hourglass) diameter size varies¹⁰.
- Dentition presence or absence: One factor determining length variation of the IC is presence or absence of patient's dentition, whether he is dentate or toothless^{6, 10}. Therefore, the canal is significantly larger in diameter in those toothless patients than in those included in dentate groups.
- Age: Distance from the IC to the maxillary central incisors is significantly lower in youngsters compared with an older group¹³. This result could be motivated by the continuous change in the form of the maxilla until the sixth decade of life. On the other hand, Liang X⁶ demonstrated the existence of a positive correlation between patient age and canal diameter.

Regardless of the results presented and according

to the objective of this study, it is imperative to mention some limitations; for example, the search was performed systematically only for those articles published in the Medline database in the past ten years. In this way, items which may have altered general conclusions could have been excluded. Also, it may present article selection bias, due to language variations and anatomical nomenclature, which could affect the search strategy and study selection. To control that, researchers previously conducted a pilot reading of articles associated with the purpose of the study and a review of classical anatomical literature, mainly based on the text "Feneis: anatomical nomenclature illustrated"² looking for operational definition of the variables to be analyzed. Lastly, there are differences in the radiographic equipment and measurements made by the researchers in the three articles finally selected, resulting in conflicting measurements which could affect the final result when comparing measurements presented.

Despite these limitations, the investigators used search strategies, sensitive selection criteria and were specific on data collection and comparison, as advised by The Cochrane Manual¹⁵ for designing systematic reviews. Moreover, this review is meant to contextualize morphometric differences in the IC at a local level to express presence of anatomical variations and their importance at the moment of operating on this region of the oral cavity to the clinical world.

In conclusion, it is agreed that males have a greater length and diameter, as well as longer distance between the apex and the middle third of the root of the maxillary central incisors, compared to females. It was possible to gather information about sexual dimorphism in the incisive canal out of reviewed literature from the last five years, finding contradictions as to shape and variations of the incisor canal regarding sex of the individual.

It is proposed to investigate about sexual dimorphism in the IC in different human races, establishing anatomical and topographical comparisons.

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