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Panoramic radiography assessment about difference of morphometric and position of mandibular canal in relation to gender at the age of 17-20 years

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Abstract
Significant differences were found in the analysis of measurement and position of the mandibular canal in relation to gender that can be caused by multiple factors such as hormone and masticatory muscle tension. The aim of this study was to understand the difference in measurement and position of the mandibular canal in relation to gender at the age of 17-20 years. The type of this study is observational analysis with 50 samples consisting of 25 male and 25 female subjects. Analysis was done using unpaired T-test with a confidence interval of 95% whereby significance was obtained when $p<0.05$. the result was the mean value of the vertical linear measurements of the left mandibular canal showed that measurements D1, D2, D4, D5, D6 and D7 was larger in male compared to female, but measurements D3 was larger in female compared to male. The mean value of ratios R! and R2 was larger in female while R3 was shown larger in males. The most frequent position of the mandibular canal showed a relation of proximity to the roots of the mandibular third molar. This concluded that there is a significant difference found in vertical linear measurements D1, D2, D4, D5, D6 and D7 of the mandibular canal but there is no significant difference in position of the mandibular canal in relation to gender.

Keywords: Mandibular canal, measurements, position, gender, panoramic radiography

1. Introduction
The mandibular canal is a canal located on the surface of the medial mandibular ramus and runs along from the mandibular foramen to the mental foramen. The mandibular canal is also a bony canal in the mandible that is the passageway for a portion of the trigeminal nerve and veins that supplies blood to the lower teeth [1].

A study by Amorim *et al* (2009) on morphological description of mandibular canal in panoramic radiographs concluded that the position and the measurements of the mandibular canal are influenced by gender [2]. A study by Rashid *et al* (2011) on morphometric analysis of mandibular canal course and position in relation to gender and age of Iraqi samples concluded that there is a significant difference in six linear measurements of the mandibular canal between male and female. In male, the position of the mandibular canal is closer to the apexes of the tooth and the vertical measurements are larges compared to female [3].

Enlow & Hans (2002) stated that in an adult, the rate of growth of the mandibular is faster in male and the craniofacial dimension of a male is larger as much as 5% - 9% compared to a female [4]. Another study by Rashid *et al* (2011) on sex determination using linear measurements related to the mental and mandibular foramen concluded that the position and measurements of the mandibular canal was higher in male [5].

Panoramic radiography also known as orthophantography and panoramic tomography can capture a complete representation of the upper jaw, lower jaw, teeth, temporomandibular joint and also a part of the maxillary sinus. This amazing quality of panoramic radiography allows dentists to record and analyze all the masticatory components and its interrelationship [6].

There are many complications that can occur when using local anesthetics in the mandibular. This can be avoided by taking a panoramic radiograph before any treatment especially during surgery for impacted 3rd molar, implants and split ramus osteotomy to avoid damaging the IAN in the mandibular canal that can cause complications like bleeding, paralyzing and trauma [7].

2. Materials and Method

The type of this study is observational analysis with cross sectional planning. The technique of obtaining samples was done by simple random sampling. The amount of samples used was 50 samples consisting of 25 male subjects and 25 female subjects with these criteria's included, student of the dentistry faculty aged 17-20 years and has agreed and signed the informed consent form. The excluded criteria are sample has sustained trauma to the lower jaw, edentulous at the posterior of the lower jaw and suffering from a systemic disease.

The selection of sample was done by handing questioners to the samples and later screened to fit the criteria's. The selected sample was given an informed consent form and later was taken to the Radiology department of the dentistry faculty of USU to take a digital panoramic radiograph. Morphometric measurements of the mandibular canal were taken as stated:

- D1 - Vertical distance of the most inferior point of the image of the inferior edge of the mental foramen to the image of the inferior limit of the mandible base.
- D2 - Vertical distance of the most superior point of the image of the superior edge of the mental foramen to the image of the superior limit of the alveolar crest of the region between the mandibular premolars.
- D3 - Vertical distance of the image of the inferior cortical of the mandibular canal to the inferior limit of the mandible base, in the height of the image of the anterior edge of the mandibular ramus.
- D4 - Vertical distance of the image of the superior cortical of the mandibular canal to the inferior limit of the image of the oblique line in the height of the image of the anterior edge of the mandibular ramus.
- D5 - Vertical distance of the most inferior point of the image of the inferior cortical of the mandibular canal to the inferior limit of the mandible base.
- D6 - Vertical distance of the most inferior point of the image of the mandibular notch to the image of mandibular foramen.
- D7 - Vertical distance of the most inferior point of the image of the mandibular notch to the image of the inferior edge of the mandibular ramus.

The position of the mandibular canal was visually recorded using Madeira (2003) as stated:

- Position 1 - There is a relation of proximity of the mandibular canal image only with the image of the root of the mandibular third molar.
- Position 2 - There is an absence of proximity between the mandibular canal and the roots of mandibular teeth.
- Position 3 - There is a relation of proximity between the mandibular canal and the roots of all the mandibular teeth.

Data was collected by computerization cumulated with SPSS version 19 and later analyzed. The statistical data collected in this study is the mean value of the vertical linear measurements of the mandibular canal of male and female. To calculate the difference of the measurement between the two groups, an analysis using unpaired independent T-test with a confidence interval of 95% and the significance was shown if $p<0.05$.

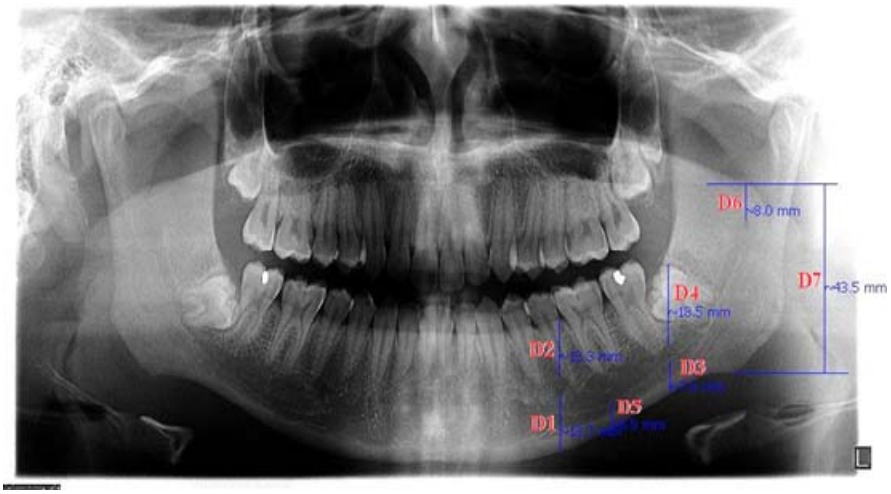

Fig 1: measurements of the left mandibular canal D1-D7 (personal documentation)

3. Results

The mean value of the vertical linear measurements of the left mandibular canal shows that measurements D1, D2, D4, D5, D6 and D7 are larger in male compared to female but, measurements D3 is larger in female compared to male. The mean value of ratios R1 and R2 are larger in female while R3 has shown larger in men.

Table 1: Statistics of mean value of the mandibular canal measurements.

Measurements(mm)	Male	Female
D1	13.1	11.17
D2	16.0	13.18
R1	0.20	0.87
D3	9.9	10.16
D4	15.31	13.06
R2	0.71	0.82
D5	7.83	6.8
D6	10.14	8.06
D7	44.26	39.25
R3	0.23	0.21

Results collected from male and female of the position of the mandibular canal show that the most frequent position is position 1 which is There is a relation of proximity of the mandibular canal image only with the image of the root of the mandibular third molar, and from this point, there is a gradual removal of the mandibular canal in relation to the roots of other mandibular teeth.

Table 2: Statistics of position of the mandibular canal Madeira (2003).

Gender	Position of mandibular canal		
	1	2	3
Male	11 (44%)	5 (20%)	9 (36%)
Female	13 (52%)	4 (16%)	8 (32%)

Results from the analysis using independent T-test show $p<0.05$ for the measurements of D1, D2, D4, D5, D6 and D7. For D3 $p>0.05$.

Table 3: Analysis of D1-D7 using independent T-test.

Measurements(mm)	Significance (2-tailed)
D1	0.001
D2	0.000
D3	0.681
D4	0.021
D5	0.031
D6	0.020
D7	0.001

Results from the analysis using independent T-test show that ratio R1, R2 and R3 $p>0.05$.

Table 4: Analysis of R1, R2 and R3 using independent T-test.

Measurements(mm)	Significance (2-tailed)
R1	0.550
R2	0.172
R3	0.317

4. Discussion

The results obtained in this study show that the mean of D1 is larger in in male (13.1) compared to female (11.17) and there is a significant difference (p = 0.001). In D2, it shoes that the mean value is larger in male (16.0) than female (13.18) and there is a significant difference (p = 0.000).

R1 (D1/D2) is measured to obtain the position of the mental foramen. Results show that p (0.550) whereby there is no significant difference between the position of the mental foramen between male and female. The result are similar to results of studies conducted by Amorim *et al* (2009) and Rashid *et al* (2011) that state the position of the mental foramen does not differ by gender. The position of the mental foramen is located lower towards the base of the mandibular ramus. This result is supported by Teerijoki-Oksa *et al* (2002). Determining the position of the mental foramen is very important when injecting anesthetics to the mental nerve and also treatment of implants in the premolar region [2, 3, 5].

In measurements of D3, the mean value in female (10.16) is larger than in male (9.9) but no significant difference was found (p = 0.681) between the male and female. The mean value of D4 is shown larger in male (15.31) than in female (13.06) and there is a significant difference (p = 0.021).

R2 (D4/D3) is measured to determine the position of course of the mandibular canal. Results obtained show that there is no significant difference in the position of the course of the mandibular canal between male and female (p = 0.172). The result is similar to the study by Simonton *et al* (2009), Amorim *et al* (2009) and Rashid *et al* (2011) that states there is no difference in the position of the course of the mandibular canal in relation to gender [2, 3, 8]. In general the position of the inferior alveolar nerve in the mandibular canal is located at the same point in both female and male. The position of the course of the mandibular canal is located approximately in between the alveolar crest and the base of the mandibular ramus [3].

D5 is measured to determine the curvature of the mandibular canal. The mean value of D5 was larger in male (7.83) than in female (6.8) and there is a significant difference between male and female (p = 0.031). The results for D5 are also similar with studies conducted by Amorim *et al* (2009) and Rashid *et al* (2011) stating that the position of the most inferior point of the cortical of mandibular canal is lower and closer to the base of the mandible in female [2, 3].

For D6, the mean value was larger in male (10.14) than in female (8.06) and there was a significant difference found (p = 0.020). For measurement D7, it was also found that the mean value was lager in male (44.26) than in female (39.25) and a significant difference was found between the genders (p = 0.001).

R3 (D6/D7) is calculated to determine the position of the mandibular foramen. Results show that there is no significant difference in the position of the mandibular foramen between male and female. This result are similar to the studies by Amorim *et al* (2009) and Rashid *et al* (2011) whom state that the position of the mandibular foramen is located in the middle region of the mandibular ramus, whereby the location is approximately half of the vertical length of the mandibular ramus [2, 3]. These results are important in treatment planning for surgical cases that involve the mandibular ramus. In surgical cases, determining the correct position of the mandibular canal can avoid complication like bleeding and permanent damage to the mandibular foramen [3]. Sagittal osteotomy treatment on the mandible that is conducted for orthoganathy treatment the positioning of the mandibular foramen is crucial. By calculating the average value, the position of the mandibular foramen can be estimated and determined. This can ensure a position for the anesthetic needle to enter [3, 9].

This study shows that the measurements of D1, D2, D6 and D7 were larger in men. The results are similar to previous studies Amorim *et al* (2009) and Rashid *et al* (2011) [2, 3]. Enlow & Hans (2002) stated that in the adult phase, the rate and speed of growth are bigger in men, with the result that craniofacial dimensions in this gender are from 5 to 9% bigger when compared with those of women. Bone growth in the adult phase can be controlled by multiple factors. Sex hormones, such as estrogen and progesterone can influence in the speed of bone growth in this phase, contributing to the development of craniofacial morphologic differences between the genders. Furthermore, the muscular tension is considered an inductive factor of bone formation, and in the mandible, the contraction of the elevating muscles during masticatory movements exerts tension throughout the mandibular ramus. In general, men have stronger masticatory muscles than the women. These two factors can explain the differences found between the genders in the measurements D1, D2, D6 and D7 [4].

This study also studies the position of the mandibular canal Madeira (2003). The results obtained show that, in both male and female the most frequent position of the mandibular canal was position 1. The result of this study is the same as a study

conducted before Rodrigues *et al* (2011). The result states that the position of the mandibular canal is not influenced by gender [10, 11]. the position of the mandibular canal was found in proximity to the apexes of the third molar, hereby allowing a big risk in extracting the tooth. The knowledge about the position of the mandibular canal is important during and also after endodontic treatment for the posterior region [12]. It is also important to know the position of the inferior alveolar nerve to avoid any iatrogenic errors [13]. Dentist should be careful during the process of extracting the third molar to avoid any damage to the IAN [3]. The risk of damage to the inferior alveolar nerve during extraction of the third molar is as much as 0.5% - 5%.

This study concludes that there is a significant difference in six vertical linear measurements of the mandibular canal but there is no significant difference in position of the mandibular canal in relation to gender.

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