

**The National Ribat University**

**Faculty of Graduate Studies & Scientific Research**



**Anatomic Variations of Mandibular Canal among  
Sudanese Population**

**A Thesis submitted in partial requirement of MSc in Human  
and Clinical Anatomy**

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٢٠١٨م

# الآية

قوله تعالى:

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿اقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ (1) خَلَقَ الْإِنْسَانَ مِنْ  
عَلَقٍ (2) اقْرَأْ وَرَبُّكَ الْأَكْرَمُ (3) الَّذِي عَلَّمَ  
بِالْقَلَمِ (4) عَلَّمَ الْإِنْسَانَ مَا لَمْ يَعْلَمْ (5)﴾

بِسْمِ اللَّهِ  
الرَّحْمَنِ  
الرَّحِيمِ

العلق : (1) ﴿

# رأى هداى

الى مروح والدتي التي طالما اقتقدتها وما نزلت . . . . . طيب الله ثراها

الى والدي العزيز مصدر قوتي اطل الله عمره . . .

الى نروجي الحبيب الذي كان له الفضل بعد الله عز وجل في هذا العمل بدعمه ومساندته

لي . . .

الى كل اخوتي وافراد اسرتي . . .

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## *Abstract*

**Background objectives:** : Mandibular canal (MC) is a canal within the mandible that contain the inferior alveolar nerve, inferior alveolar artery ,and inferior alveolar vein. It runs obliquely downward and forward in the ramus and then horizontally forward in the body of the mandible, where it is placed under the alveoli and communicates with them by small openings. The objectives of this study is to assess the anatomic variation of the mandibular canal among Sudanese population.

**Material and Methods:** This study was conducted on 150 digital panoramic radiographs of adult Sudanese population. The distance from the superior border of the MC to the AC at the retro molar area ,and the distance from the LB were measured using easy dent viewer4 program. The ANOVA and SPSS, version 18 software were used for the statistical analysis, to calculate these distances.

**Results:** The distances from the MC to AC and to LB of the mandible was different according to age and gender and in both right and left sides. The distance from the MC to AC in males(9.73mm) whereas in female(9.93mm) and the distance from the MC to LB in males(16.48mm) whereas in females (14.72mm)

**Conclusion:** The knowledge of these distances will be of much use to dental surgeons specially in surgical procedures.

In comparison my findings with other studies, it was found that distance of the mandibular canal from the inferior border of the mandible ranged from 9.4mm to 16.3mm differed according to gender and age.

## ملخص الدراسة

**الخلفية والأهداف:** قناة الفك السفلي: هي قناة داخل الفك السفلي تحتوي على الشريان السنخي السفلي والوريد السنخي السفلي والعصب السنخي السفلي. تجري بشكل غير مباشر الي اسفل والي الامام في رام الفك السفلي وافقيا في جسم الفك السفلي حيث تمتد تحت الحويصلات الهوائية وتتواصل معها من خلال قنحات صغيرة.

**المواد والطريقة:** وقد أجريت هذه الدراسة على مائة وخمسون صورة بانورامي رقمية في منطقة الفك السفلي للبالغين من سكان السودان من حيث العمر والنوع. كما تم قياس المسافات من القناة الي السقف السنخي في منطقة خلف الرحي ومن القناة الي الحد السفلي من الفك باستخدام برنامج قياسات رقمي لأشعة الاسنان. وباستخدام برنامج التحليل الاحصائي وانوفا لمقارنة تلك القياسات .

**النتائج:** المسافة من قناة الفك السفلي الي الحد السفلي للفك ومنها الي المنطقة خلف ضرس العقل تختلف بحسب الجنس والعمر والاتجاه ايضا (يمين او شمال).

**الخاتمة:** تفيد الدراسة ان المسافات وتغيراتها قد تكون ذات فائدة كبيرة لأطباء الأسنان خاصة في اجراء العمليات الجراحية في هذه المنطقة.

وبمقارنة نتائج دراستي مع نتائج الدراسات السابقة لنفس الموضوع وجد ان المسافة من قناة الفك السفلي الي الحد السفلي للفك تتراوح بين 9.4 الي 16.3ملمتر بحسب العمر والجنس.

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## **List of Abbreviations**

MC mandibular canal

AC alveolar crest

LB lower border of the mandible

# 1.Introduction & Objectives

## 1.1.Introduction

The mandibular canal is a channel extends from the mandibular foramen located on the median surface of the ramus, the posterior section of the mandible which is somewhat vertical in appearance. It is present inside the mandible that consists of inferior alveolar vein , inferior alveolar nerve , inferior alveolar artery.

This internal canal runs transversely through the middle of the mandible and comes from posterior to anterior. It runs downward in an oblique manner and then forward in the ramus. It then moves horizontally inside the body , where it is located under the alveoli through small openings.

It runs parallel to the mandibular foramen and the mental foramen. It is the mandibular foramen that provides an exit for the vessels and mental nerve from the canal. This special channel carries branches of the inferior alveolar nerve , vessels and artery that communicates with the dental alveoli through tiny passages.

In 50% radiographs , the canal is found to be somewhat closely located to the vertices of the second molar. It is detected to be away from the root apices in 40% radiographs. In only 10% the vertices seem to get through the canal.

The canal houses vascular and neural tissues. Naturally it is subjected to pathology related with the tissues. The canal exhibits neural tumors as well as vascular tumors.<sup>(1)</sup>

The study of Rajchel et al <sup>(2)</sup>, on 45 Asian adults demonstrated that the MC, when proximal to the third molar region, is usually a single large structure, 2.0 to 2.4mm in diameter. Ikeda et al <sup>(3)</sup> conducted similar study and reported that canal is approximately 3.4mm wide. Anterior to the mental foramen the MC is referred to as the incisive canal<sup>(4)</sup>.

It was reported that MC might have different anatomic configurations in the horizontal plane. Usually the MC crosses from the lingual to the buccal side of the

mandible and in most cases the midway between the buccal and the lingual cortical plates of bone is by the first molar.

Kim et al classified the buccolingual location of the MC into 3 types: type 1 (70%) where the canal follows the lingual cortical plate at the mandibular ramus and body ;type 2(15%), where the canal follows the middle of the ramus behind the second molar and the lingual plate passing through the second and first molars; and type 3 (15%) ,where the canal follows the middle or the lingual one third of the mandible from the ramus to the body<sup>(5)</sup>.

**Justification:** The great development of the surgical techniques in the mandible and the progress of the radiological imaging procedures have brought much interest in the clinical anatomy of the mandibular canal

The aim of this study was to measure the distances from the mandibular canal to the alveolar crest in the retromolar area and from the mandibular canal to the lower border of the mandible in healthy adult individuals, who had panoramic X-ray from mandibular area.

Knowledge of these distances in addition to the anatomy and location of the mandibular canal are essential for successful procedure in the region of the jaw such as wisdom teeth extraction and implant placement.

## **1.2.Objectives:**

### **➤ General objectives:**

To assess the anatomic variations of the mandibular canal among Sudanese populations.

### **➤ Specific objectives:**

To:

- Assess the anatomic variations of MC among males and females.

- Determine the distance of the MC from the alveolar crest in the retro molar area and to the lower border of the mandible.
- Assess the anatomy of mandibular canal and associated neurovascular bundles in relation with dental implant and surgical procedures.

**Ethical considerations:**

Approval of this study was obtained from the ethical committee of the National Ribat University & Al-Mazin dental center; the confidentiality of the participants will be assured through hiding names and addresses.

## 2.Literature Review

Apostolais & Brown<sup>(6)</sup>, studied the dimensions of the mandibular canal and its spatial relationship to various anatomical landmarks of the mandible using cone beam computed tomography(CBCT). One hundred patients were scanned for dimensions of mandibular canal, and the distance from the various mandibular landmarks. They found that a mandibular canal was identified by CBCT in 93% of the cases and with a mean length of 8.9mm.The mean distance from the canal to the root tips of the premolars ,canines ,and incisors were 6.9mm,7.3mm ,and 10.4mm respectively. The mean distance from the canal to the buccal cortical border in the same tooth positions were 2.8mm ,4.4mm, and 4,8mm respectively.

Pires, et al<sup>(7)</sup>, studied the mandibular canal .The aim of this study was to assesses CBCT compared with panoramic radiography to verify the presence, location, and the dimensions of the mandibular canal. CBCT scan images and panoramic radiograph of 89 subjects were compared for the presence of the mandibular canal , its location ,size , and anterior-posterior length. 83% of the CBCT showed the presence of the canal , as did 11% of the panoramic radiographs. The mean length of the canal was 7mm. The distance from the inferior border of the mandible to the canal was 10mm. The presence ,location and dimension of the mandibular canal are better determined by CBCT imaging than the panoramic radiograph.

Ramesh, et al<sup>(8)</sup>, studied the prevalence of the mandibular canal its average location and dimension in Indian population using cone beam computed tomography(CBCT).CBCT scan images of 120 subjects were analyzed for the presence of mandibular canal ,its location ,size, and its length. The average diameter of the canal was 2.5mm . The distance from the inferior border to the origin of the mandibular canal was 9.4mm and to the apex of the canal was 9.09mm. The distance from the buccal cortex of the mandible to the origin of the canal was 1.48mm, and to the apex of the canal was 4.4mm. The distance from the

lingual cortex to the origin of the canal was 4.4mm, and to the apex of the canal was 5.5mm.

Khorshidi ,et al<sup>(9)</sup>, studied the course and position of the mandibular canal using CBCT. It was found that there was statistically significant correlation between the anatomic course of the canal and the patients' gender. The mean vertical position of the canal, as measured from the lower border of the mandible was 8.5mm. On average the mandibular canal was situated more lingually at all sites to the point it reached the mental foramen. However , at the mental foramen region , it was located closer to the buccal cortical plate.

Villaca- Carvalho, et al<sup>(10)</sup>, studied the prevalence of bifid mandibular canal by CBCT. The examined CT scans from 300 patients included males and females, aged 25 to 87 yrs. BMC was observed in 80 cases (26.67%),of which, 39(48.75%) were in male and 41(51.25%) in females. The prevalence of BMC is significant and should not be over-looked.

Nemati, et al<sup>(11)</sup>, determined visibility and anatomic variation of mandibular canal in digital panoramic radiographs of dentulous and edentulous patients in Northern Iran population using 249 digital panoramic radiographs in dentulous group and 126 in edentulous group. They examined canal to alveolar crest distance , and canal to lower mandibular border distance. High position was more frequent in females and intermediate position was more common in males. In edentulous group no correlation was found between age, gender ,and canal position. The best visibility of mandibular canal was in its third posterior and the least was in its third anterior part.

## **3. Materials and Methods**

### **3.1. Study design:**

This is an observational analytic cross-sectional study to evaluate the anatomic variations of the mandibular canal in Sudanese subjects depending on their age and sex.

### **3.2. Study area :**

The study will be conducted in AL-MAZIN dental centre.

### **3.3. Study population:**

#### **3.3.1. Inclusion criteria:-**

Healthy adult individuals who did not suffer from any jaw disease and had X-ray from mandibular area for impacted third molar.

#### **3.3.2. Exclusion criteria:-**

The age of the subjects ranged from 20-45 years with the mean of 25 year, 150 radiographs were selected after those with the following criteria were excluded:

- Patient under 20 years of age.
- Presence of radiolucent lesions in the lower jaw.
- Patient undergoing/already underwent orthodontic treatment
- Patients with mandibular fractures or other pathological conditions affecting the course of the mandibular canal.

### **3.4. Study duration:**

February to June 2017.

### **3.5. Study instruments ( techniques and tools)**

Digital panoramic radiograph of 150 patients will be retrospectively analyzed for the position of the mandibular canal . All the panoramic radiographs were taken using orthophos XGS Ds/ceph (tube potential: 60-90kv, tube current: 3-16mm, effective focal spot :0.5mm and exposure time:14.1seconds.

### **3.6.Data analysis**

The measurements were studied for two sides of the jaw and statistically analyzed by mean and standard deviation, The researcher measured the distance of the mandibular canal in mm, from fixed landmarks including, canal to alveolar crest at the retro molar area and canal to lower border of the mandible.

## 4.Results

In this study 150 digital panoramic radiograph which are taken from al-mazin dental clinic using orthophos XGS DS/ ceph( tube potential:60-90kv, tube current :3-16mm)

The number of patients selected were 150, 52%males ,48%females in relation to gender(table1,figure1).

In relation to age, the criteria of selection included healthy individuals who didn't suffer from any jaw disease between the age group from 20-45 years, According to the age it was found that 36%were within the age of 20-24 years while 15% were above 35years (table2, figure 2)

According to the gender the mean distance from the MC to AC and from the MC to the LB in both males and females it was the found that, the distance from MC to AC in males was (9.73mm) whereas in females was (9.98) on the right side, and the distance from the MC to the LB in males was(16.48mm) whereas in females was (14.72)on the right side.(Table 3,Figure 3).

The mean distance from the MC to AC in males was(9.93mm) whereas in females was (10.17mm) on the left side. The mean distance from the MC to LB in males was (18.01mm) whereas in females was (19.50mm) on the left side .(Table 4,Figure 4).

In the age group 25-29yrs the distance from the MC to LB on the right side was (16.38mm);and the distance from MC to AC was 9.95mm. On the left side the distance from MC to LB was 23.1mm ,whereas the distance from MC to AC was 9.00mm. Above 35 yrs. the distance between the MC & the LB decreased ,and similarly the distance between the MC and the AC (Table 5,6 , Figure 5,6).

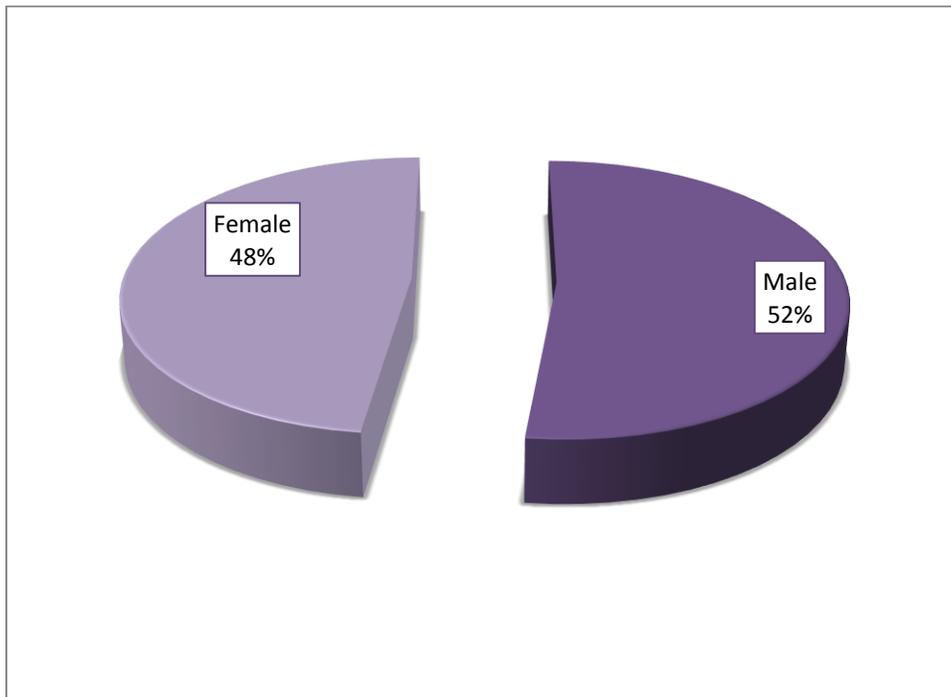
In comparison between right and left side according to gender ,there a was significant difference between right MC to AC distance.(Table 7).

In comparison between right and left side according to age ,there was a significant difference between the measurement of MC to AC & MC to LB.(Table 8).

**Table (1): Distribution of the study sample according to gender**

<b>Gender</b>	<b>Frequency</b>	<b>Percent</b>
<b>Male</b>	78	52%
<b>Female</b>	72	48%
<b>Total</b>	150	100.00%

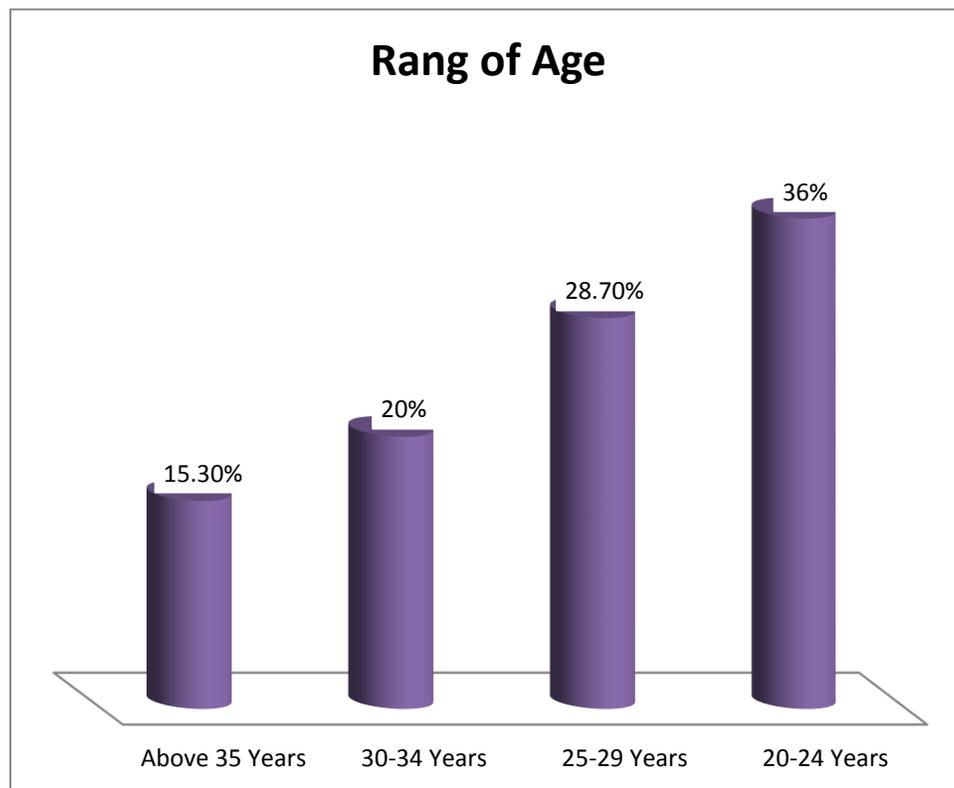
**Figure (1): Distribution of the study sample according to gender**



**Table (2): Distribution of the study sample according to age groups**

<b>Age</b>	<b>Frequency</b>	<b>Percent</b>
20-24 Years	54	36%
25-29 Years	43	28.7%
30-34 Years	30	20%
Above 35 Years	23	15.3%
<b>Total</b>	150	100.0%

**Figure (2): Distribution of the study sample according to (Age)**

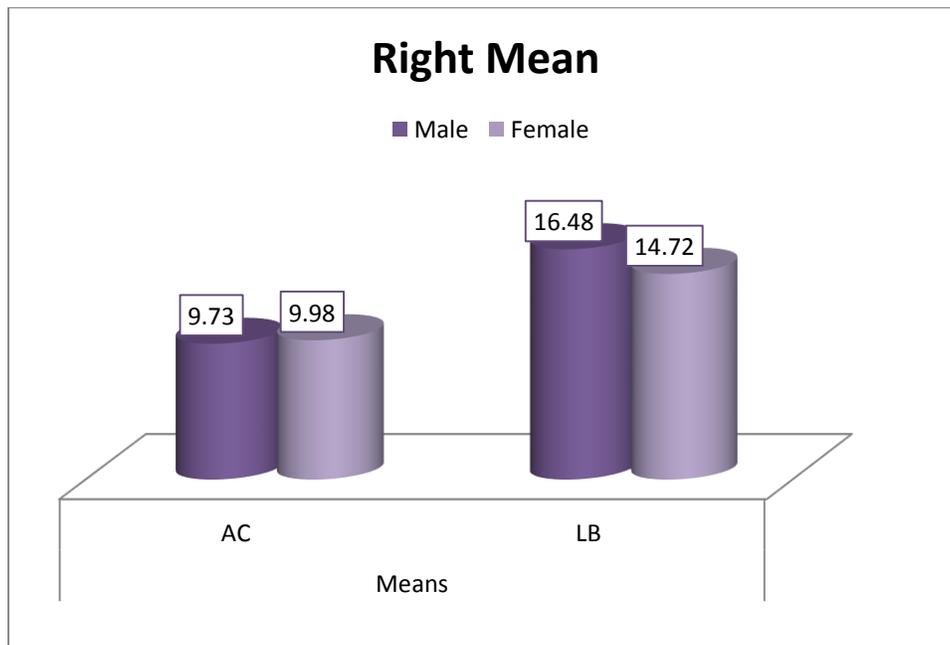


**Table (3): Distribution of the study sample according to mean distance from MC to AC & from MC to LB in males & females(right side)**

Gender	Means	
	From MC to AC	From MC to LB
Male	9.73	16.48
Female	9.98	14.72
Mean	9.85	15.64

Maximum Minimum

**Figure (3): Distribution of the study sample according to mean distance from MC to AC & from MC to LB in males & females(right side)**

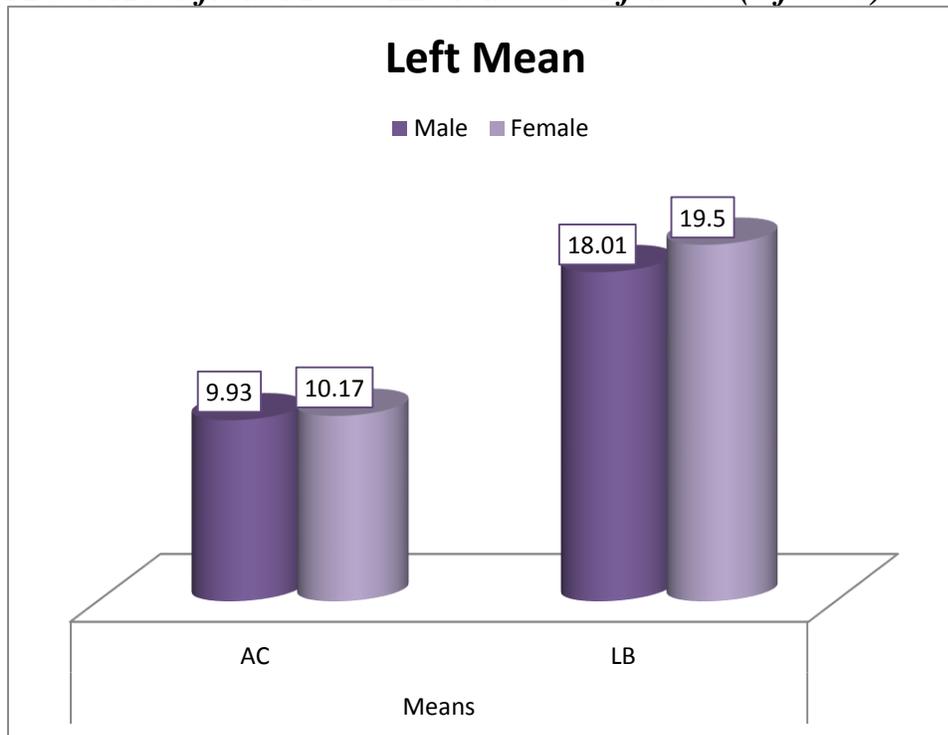


**Table (4): Distribution of the study sample according to mean distance from MC to AC &from MC to LB in males & females(left side)**

Gender	Means	
	Distance From MC to AC	Distance From MC to LB
Male	9.93	18.01
Female	10.17	19.50
Mean	10.04	18.72

Maximum Minimum

**Figure (4): Distribution of the study sample according to mean distance from MC to AC &from MC to LB in males & females(left side)**

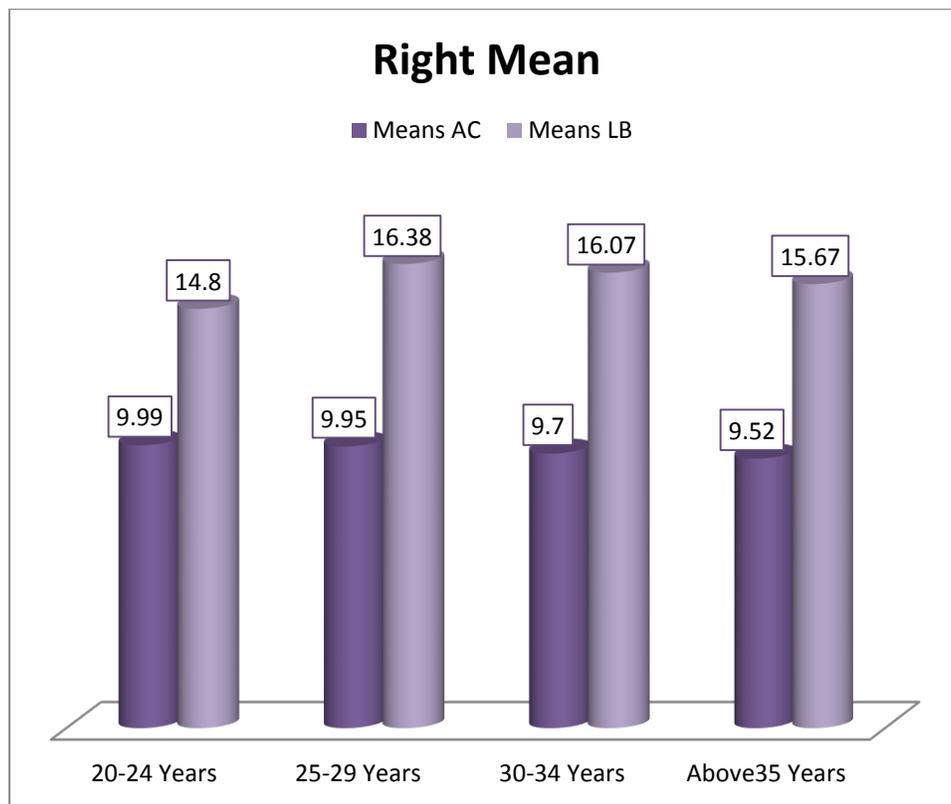


**Table (5): Distribution of the study sample according to age (right side)**

Age	Means	
	Distance from MC to AC	Distance from MC to LB
20-24 Years	9.99	14.80
25-29 Years	9.95	16.38
30-34 Years	9.70	16.07
Above35 Years	9.52	15.67
<b>Total</b>	9.85	15.64

Maximum Minimum

**Figure (5): Distribution of the study sample according to age(right side)**

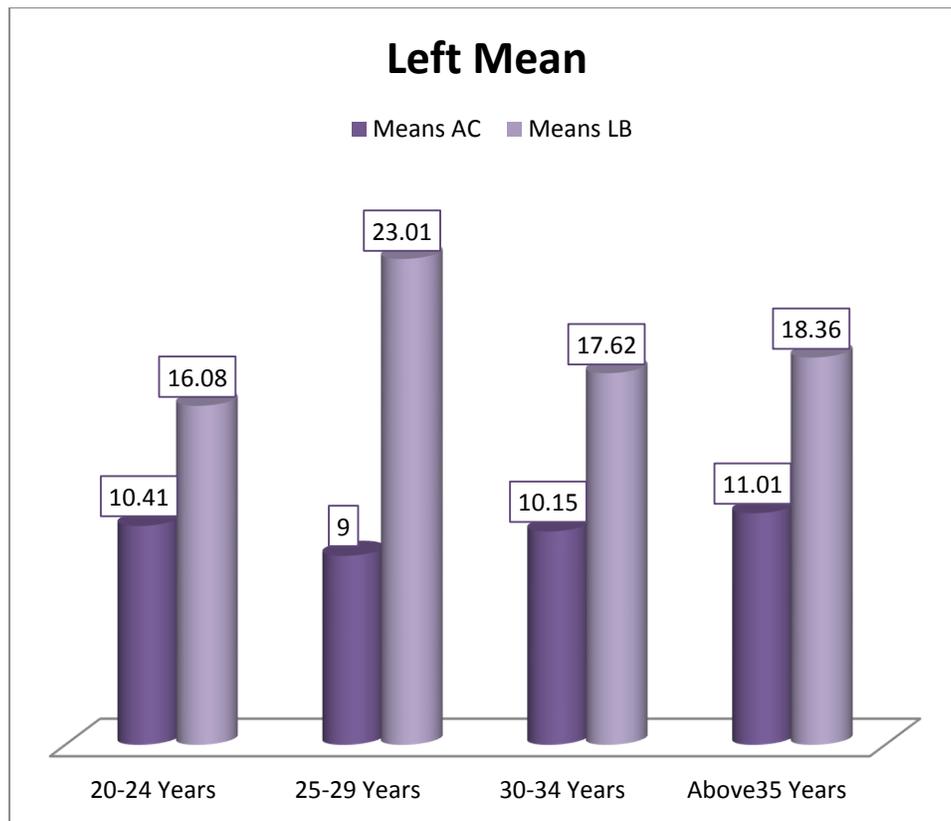


**Table (6): Distribution of the study sample according to age(left side)**

Age	Means	
	Distance from MC to AC	Distance from MC to LB
20-24 Years	10.41	16.08
25-29 Years	9.00	23.01
30-34 Years	10.15	17.62
Above35 Years	11.01	18.36
<b>Total</b>	10.46	18.73

Maximum Minimum

**Figure (6): Distribution of the study sample according to age(left side)**



**Table (7): To Comparison between Right and Left side the distance from MC to AC & from MC to LB according to gender**

**Group Statistics**

	gender	N	Mean	Std. Deviation	Std. Error Mean
R-MC to AC	male	78	9.7333	1.47028	.16648
	female	72	9.9750	1.79418	.21145
R-MC to LB	male	78	16.4891	2.61837	.29647
	female	72	14.7194	2.61494	.30817
L-MC to AC	male	78	9.9355	2.13933	.24223
	female	72	10.1661	2.38546	.28113
L-MC to LB	male	78	18.0103	11.28689	1.27799
	female	72	19.5028	16.69396	1.96740

<i>Independent Samples Test</i>		<i>P-Value</i>
Right	MC to AC	0.367
	MC to LB	0.000
Left	MC to AC	0.534
	MC to LB	0.519

\*Normal p-value is 0.05; therefore the statistical difference is highly significant.

( $P\text{-Value} \leq 0.05$  Significant difference between Right (MC to AC distance) according to gender.

**Table (8): To Compare between Right and Left side the distance from MC to AC & from MC to LB According to Age**

<i>One Way -Anova</i>		<i>P-Value</i>
Right	MC to AC- Between Groups	0.643
	MC to LB- Between Groups	0.029
Left	MC to AC- Between Groups	0.002
	MC to LB- Between Groups	0.05

\*Normal p-value is 0.05; therefore the statistical difference is highly significant.

(*P-Value*  $\leq 0.05$  Significant Difference between Right & Left (MC to AC & MC to LB) according to A

## 5. Discussion

In the present study ,one hundred and fifty panoramic radiograph were analyzed according to patient age and gender. Panoramic radiograph comprises 78 males &72 females between 20 -45 yrs old. Patients with history of orthodontic treatment and cases with fractures in the ramus and body of the mandible were not included in this study.

In previous study(3) dimensions of mandibular canal and the distance from various mandibular landmarks were scanned using CBCT. The distance from inferior border to the origin of the mandibular canal was 9.4mm , whereas in this study the distance from the inferior border to the middle of the MC was measured according to age and gender and on both right and left sides(table 3 figure3, table 4 figure4 ,table 5 figure 5 table 6figure 6). According to gender it was found that the distance from the inferior border to the MC is larger in males than in females (table 7).

In present study , also the distance from the MC to AC of the retro molar area was measured. The aim of this measurement was to know the position of the MC so that to avoid injury to its contents during the surgical procedures in the wisdom tooth. It was also found that as the age increase the MC to AC distance increase, and the MC to LB distance decrease.

In comparison of this study with previous studies , in this study panoramic radiograph was being used in determining the distances, whereas most of the previous studies using CBCT which is more accurate method than the panoramic radiographs in studying jaw measurements.

## **6. Conclusions & Recommendations**

### **6.1. Conclusions:**

- ❖ Knowledge of location of mandibular canal in the maxillofacial region is necessary in a clinical situation especially surgical procedures in order to avoid injury to corresponding neurovascular bundles.
- ❖ In the present study, panoramic radiograph were utilized because they have certain advantages over intra-oral radiography. These include a greater area of hard and soft tissue and also the ability to visualize adjacent areas, thus allowing for localization of the mandibular canal dimensions.
- ❖ Anatomical variations were seen according to gender and age.
- ❖ The distance from the MC to the lower border of the mandible was greater in males than in females. The distance from MC to AC and from MC to LB of the mandible decrease as the age increases.
- ❖ No significant differences between left and right sides in both males and females.
- ❖ The highest measure between MC and the lower border of mandible (23mm) was found in young males.

## **6.2.Recommendations:**

- ❖ The knowledge of anatomic variations of the mandibular canal should be considered by clinicians for better and proper postoperative outcomes.
- ❖ The present study was limited to the evaluation of the distances from fixed points to the MC using digital panoramic radiographs of a small sample of Sudanese subjects therefore larger sample size is needed.
- ❖ Further studies utilizing a larger sample size in different study areas and evaluating all the vertical and horizontal dimensions from the mandibular canal using quantitative measurements and advanced imaging modalities are needed.

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