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Location of mandibular foramen in adult black South African population: A morphometric analysis and investigation into possible radiographic correlation

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Abstract

Introduction
The mandibular foramen (MF) is located bilaterally just above the centre of internal surface of ramus of mandible, however, its exact position varies amongst different population groups.

Aim
The aim of this study was to determine the exact location of mandibular foramen among black South African population using a possible correlation of radiographic and morphometric analysis.

Methods
A retrospective, cross-sectional study was conducted on a total of 253 adult dry human mandible specimens at Raymond A Dart Bone collection in the School of Anatomical Sciences, University of the Witwatersrand, and twenty-four adult cone beam computed tomographic (CBCT) records of patients in Maxillofacial and Oral Radiology Unit, situated in Charlotte Maxeke Johannesburg Academic Hospital. The length, height, and distance of MF in relation to anterior and posterior border of ramus of mandible; superior and inferior border of mandible as well as distance in relation to coronoid and condyle were measured. Descriptive statistics of mean, standard deviation and frequency was used to summarize the data.

Results
For both radiographic and morphometric analyses, distance of MF to posterior region of ramus was smaller than that of MF to anterior region. Mandibular foramen was found to be situated more towards posterior region of ramus for both radiographic and morphometric analyses in all age cohorts. Males generally showed greater readings than females in all parameters, except mandibular foramen to posterior region (MF-P) measurement. No significant difference was noted amongst different age groups.

Conclusion
The position of MF was constantly observed towards the posterior region of ramus of mandible for both radiographic and morphometric analyses which suggested that the chances of finding MF in the anterior border of ramus of mandible are limited. The anterior border of mandible can therefore be regarded as "safety zone" in a black South African population.

Keywords
Mandibular foramen, morphometric, sexual dimorphism, age

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INTRODUCTION
The mandibular foramen (MF) is an important anatomical opening found in the human mandibles. It serves as an entry point for inferior alveolar nerve (IAN) and its accompanying vascular structures known as inferior alveolar artery and vein, which navigate the mandibular canal to provide sensation and blood supply to mandibular teeth[1,2]. The varying position of MF has been reported to be the contributing factor to injury of inferior alveolar neurovascular bundle as well as failure of inferior alveolar nerve block[3].

Thangavelu et al., (2016) reported that several reasons which include absence of a specific bony landmark, variations in width and height of ramus, and variation in IAN position are responsible for failure to achieve anaesthesia[2]. Furthermore, Samanta and Kharb, (2013) reported that accessory mandibular foramen (AMF) was present in 16.66% of mandibles, and that 10% of mandibles had a single AMF, while 6.6% of mandibles had double foramina[1]. Shalini et al., (2016) found that AMF was present in 32.36% of mandibles that they examined.[4]

It is of great clinical importance for oral and maxillofacial surgeons to be able to locate both MF and AMF and be able to avoid injury to nerve and blood vessel while carrying out surgical procedures like bilateral sagittal split osteotomy (BSSO) which are usually performed in orthognathic surgery[1,5,6].Procedures for corrections of mandibular skeletal abnormalities, implant placement and in plastics and reconstructive surgeries also carry risk of damage to the nerve.

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There are reports on post-operative complications such as paresthesia of lower lip due to injuries on IAN[7]. The IAN can be attached to proximal segment of mandible at approximately 39% of BSSO sites[8]

Oncologists and radiologists should also be mindful of IAN when planning radiation therapy in the management of oral carcinomas[1,4]. Furthermore, AMF could provide multiple direct channels for invasion of tumour cells from lateral mandibular surface of cortical bone to underlying cancellous bone[11]. Therefore, maxillofacial surgeons and clinicians are compelled to be aware of location of MF to avoid such fatalities. Several authors have reported that the exact location of MF varies amongst males and females of different ages and from different population groups. [6,9,10,12]

There are no published studies thus far among South African population; therefore, there is dearth of records or data on position of MF in relation to different parameters of ramus of the mandible. Furthermore, use of CBCT in clinical dentistry has become very popular because images of CBCT are three dimensional that gives a more precise visualization of anatomical structures in maxillofacial region. Thus, this study will provide the South African morphometric data obtained from both dry adult human mandibles and radiographic data obtained from CBCT radiographs of patients with the purpose of investigating any possible correlation between the two analyses. Outcome of the investigation will, therefore, facilitate the location of MF in relation to different borders of ramus of mandible, considering sex and age aspects. The information will go a long way to provide dental clinicians with predictable indicators that will assist them to achieve a successful inferior alveolar nerve block (IANB) and surgical procedures such as sagittal split ramus osteotomies (SSRO) without inferior alveolar nerve bundle fatalities.

Aim of the study

The aim of this study was to determine the exact location of mandibular foramen among black South African population using a possible correlation of radiographic and morphometric analysis.

METHODS

Ethics

The Human Research Ethics Committee (Medical) of Faculty of Health Sciences at University of the Witwatersrand approved the study (M151106).

Study design and data collection

A cross-sectional, retrospective study was conducted on a total of 253 adult dry human mandible specimens and 24 adult radiographic data from CBCT records of patients. Both male and female specimen of ages between 16-56 years old and above were examined. Fully or partially dentate (minimum of 6 teeth) dry mandibles including second molar (teeth 37 and 47) were included in the study while completely edentulous mandibles, mandibles with evidence of deformity or pathology, mandibles that have undergone surgery and damaged (e.g., fractured) were excluded from the study. A Galaxis software measuring ruler was used for all radiographic measurements. Linear measurements and heights were calculated on tangential section and length was calculated on axial section. The CBCT images were obtained from Sidexis data base on a Galileos 3D comfort by Sirona Dental systems. All radiographs were obtained from the same machine with the following information: model: Galileos GAX 5 (Compact); serial no: 3351.

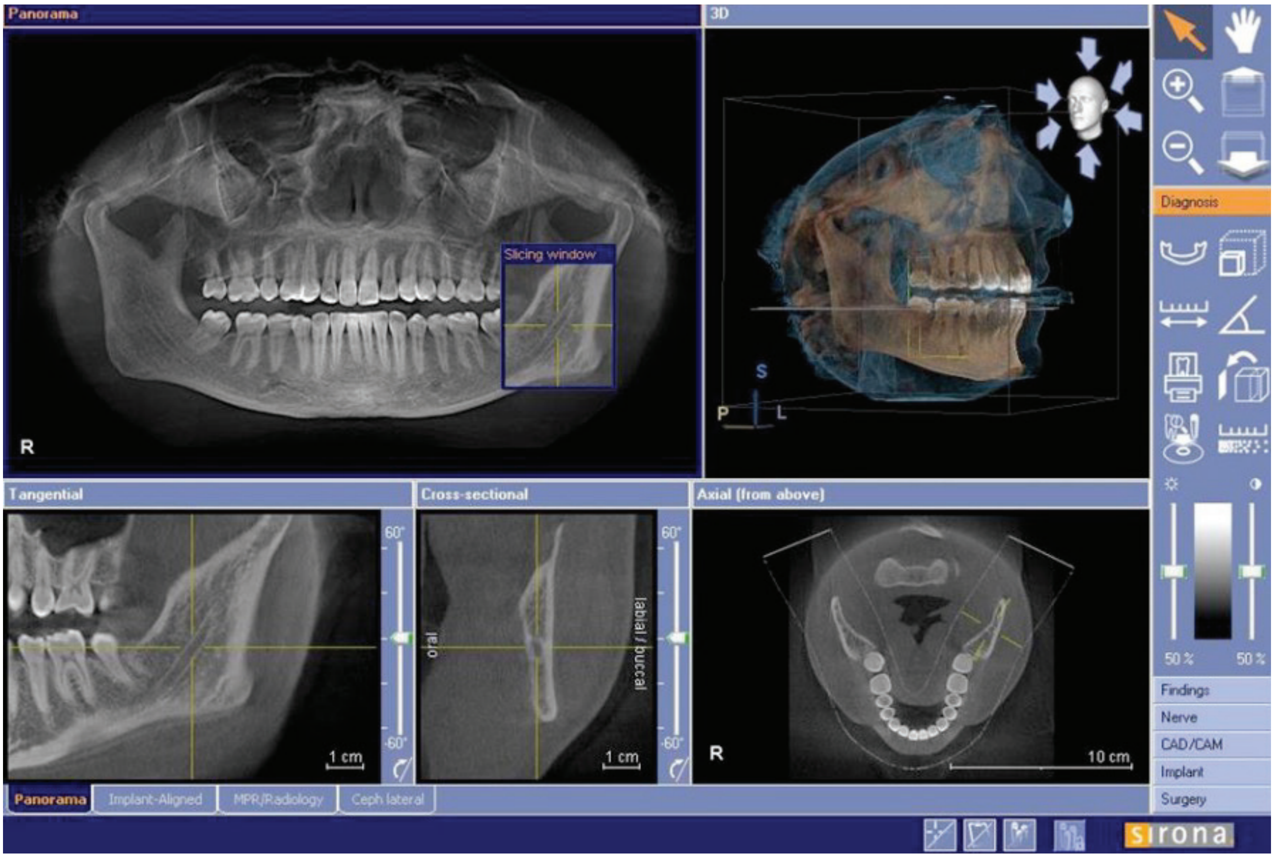

Figure 1. Illustration of some of the measurements carried out in the radiographic study. Internet accessed 23 March 2017.

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Figure 2. Mandibulometer measuring the height and length of mandibular in mm.

Figure 3. Dental digital sliding calliper measuring the distance of MF in relation to different parameters in mm.

ANATOMICAL LANDMARK	DEFINITION
MF-P	Distance from the MF to posterior border of ramus
MF-A	Distance from the MF to anterior border of ramus
MF-S	Distance from the MF to sigmoid notch
MF-GO	Distance from MF to inferior border of ramus
S-GO	Distance from the sigmoid notch to inferior border of ramus
MF-I	Distance from the MF to the highest point on the coronoid process
MF-H	Distance from the MF to the highest point on the condylar process
H-GO	Distance from the highest point on condylar head to the infe-rior border of ramus
GO-M	Length of mandible from the GO to the most anterior point on the menton
P-A	Distance from the posterior border of ramus to anterior border of ramus

Table 1. Various parameters measured on the mandible

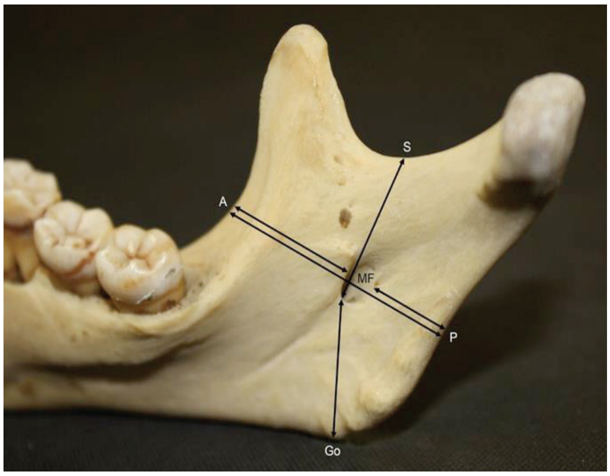
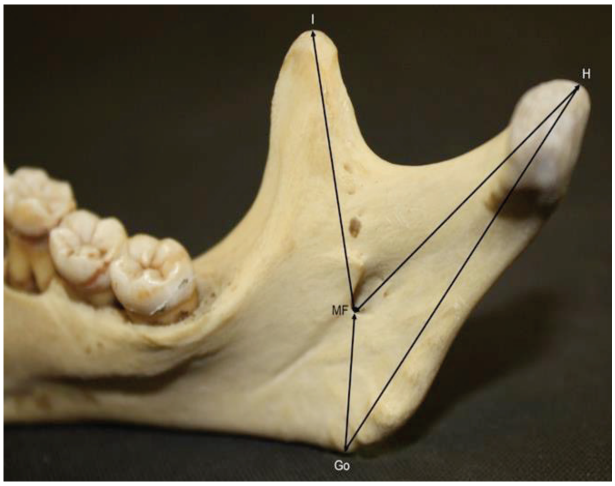


Figure 4: Internal surface of ramus of mandible. MF-A; MF-P; A-P; MF-GO; MF-S.



Figures 5. Internal surface of ramus of mandible. MF-I; MF-H; MF-GO; H-GO.

RESULTS

Table 2 outlines age distribution of morphometric measurements on both left and right sides.

The left and right P-A distance was at its highest point among age cohort 51-55 years and at its lowest point among age 21-25 years. MF-A reading was higher than MF-P distance in all samples irrespective of age. MF-S; MF-GO and S-GO increased significantly with increasing age in all the age cohorts on both left and right sides ($p < 0.05$). Table 3 shows radiographic and demographic distribution of 21-25 years age cohort (Table 3).

Males showed significantly higher readings than females in all parameters on both left and right sides except for MF-P measurement. Radiographic measurements of MF-GO, S-GO, MF-I and H-GO showed a significant difference between males and females on right side ($p < 0.05$). Except for MF-A, mean measurement of all other parameters showed no significant difference between males and females ($p > 0.05$).

Table 4 outlines comparison between means for radiographic and morphometric measurements in age cohort 21-25.

There was a significant difference on right side of almost all parameters except MF-GO, S-GO, MF-I and MF-H ($p > 0.05$). The left side also showed significant differences in all parameters except for MF-S; MF-GO and MF-I ($p > 0.05$).

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	16 - 20		21 - 25		26 - 30		31 - 35		36 - 40		41 - 45		46 - 50		51 - 55		>56	
Right	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
MF-P	14.3	2.1	13.3	1.9	13.4	2.4	13.8	1.5	13.7	2.0	13.4	1.7	13.5	2.2	14.7	1.8	13.3	1.8
MF-A	18.4	2.0	18.4	2.7	19.4	2.1	18.6	2.4	18.5	2.9	19.4	2.5	19.2	2.1	19.7	2.4	18.2	2.6
P-A	34.5	2.9	32.4	4.6	34.6	3.3	33.8	3.0	33.9	4.1	35.2	3.1	35.0	3.3	35.7	3.0	33.4	3.2
MF-S	18.1	2.8	20.6	3.1	20.4	3.3	20.7	1.7	20.6	3.2	19.0	3.0	20.3	3.3	20.9	3.1	20.2	2.7
MF-GO	21.0	3.4	22.6	3.5	22.2	3.3	22.9	3.3	22.9	4.4	24.3	4.4	23.8	3.3	22.7	3.3	23.5	3.5
S-GO	41.3	4.3	43.2	4.9	42.6	4.1	43.5	3.4	43.3	5.2	43.3	4.8	43.9	4.7	43.7	5.6	43.5	4.5
MF-I	34.8	3.6	35.3	3.8	35.8	4.1	35.2	2.9	36.2	4.1	34.5	3.9	35.2	3.1	36.9	3.1	34.7	3.5
MF-H	38.5	3.0	39.5	4.1	38.8	3.5	38.9	3.0	39.6	3.4	38.9	2.8	39.7	3.9	40.4	3.9	39.4	2.9
H-GO	46.8	6.6	49.5	7.3	49.2	6.5	49.3	6.2	49.3	6.2	50.9	5.9	51.2	7.0	50.8	7.8	49.4	7.1
G0-M	105.1	4.8	106.5	5.2	106.4	6.1	106.3	6.1	107.3	6.5	107.3	5.0	109.0	7.4	107.4	4.5	107.9	7.2
	16- 20		**21- 25**		**26- 30**		**31- 35**		**36- 40**		**41- 45**		**46- 50**		**51- 55**		**>56**	
Left	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
MF-P	14.0	2.2	13.3	2.1	13.6	2.1	13.2	1.6	13.2	2.4	13.1	1.6	13.3	2.2	14.0	2.5	13.3	1.8
MF-A	18.4	2.0	18.3	2.2	19.6	2.3	18.6	2.4	18.3	2.7	19.4	2.5	19.1	2.5	19.9	3.1	18.5	2.3
P-A	33.6	4.4	33.4	3.6	34.8	3.4	33.7	2.9	33.7	4.1	35.1	3.1	35.1	2.9	35.6	3.4	34.0	3.2
MF-S	17.6	3.1	20.5	3.3	20.3	3.4	20.3	2.0	20.6	3.3	19.6	2.8	20.5	3.3	20.3	3.2	19.8	2.7
MF-GO	21.2	3.5	21.8	3.7	22.8	3.7	21.7	3.8	22.7	3.9	24.0	4.3	23.8	2.6	22.9	3.0	23.3	3.7
S-GO	41.6	4.4	42.6	4.8	42.9	4.2	42.3	4.0	43,2	5.1	43.5	4.3	44.3	4.6	43.4	5.2	43.3	5.3
MF-I	34.8	4.1	35.0	4.0	34.6	3.7	35.0	3.3	35.6	3.7	34.7	3.6	35.2	3.5	36.3	3.3	34.5	3.4
MF-H	38.3	3.4	38.9	3.5	38.4	3.4	38.8	3.0	39.4	3.6	39.3	2.9	40.2	4.1	39.8	3.8	38.7	3.4
H-GO	47.0	6.5	47.6	7.2	47.5	9.0	47.8	6.5	48.9	6.1	49.9	5.7	51.3	6.9	50.2	7.6	48.7	7.2
GO-M	104.9	5.3	106.5	5.2	106.4	6.1	107.2	5.9	107.6	6.4	107.6	5.5	108.7	7.5	107.2	4.6	107.8	7.1

Table 2: Age distribution of the Morphology

	Male		Female		
Right	**Mean**	**SD**	**Mean**	**SD**	**Sig**
MF-P	8.8	2.1	9.6	2.8	0.41
MF-A	11.5	1.2	10.9	2.8	0.46
P-A	22.5	2.9	21.8	2.7	0.6
MF-S	24.9	4.3	22	4.9	0.14
MF-GO	22.5	2.9	19.2	2.1	0.01*
S-GO	48.7	5.1	42.8	5.1	0.01*
MF-I	38.5	4.5	34.4	4.2	0.04*
MF-H	38.6	5	37.6	2.9	0.57
H-GO	64.7	5.6	60.1	4	0.04*
GO-M	45	2.1	43.7	2.6	0.22
Left	**Mean**	**SD**	**Mean**	**SD**	**Sig**
MF-P	7.9	1.4	8.5	2.4	0.45
MF-A	12.3	1.4	9.9	2.2	0.00*
P-A	22.7	3.4	21.4	3.6	0.39
MF-S	22.7	2.8	22.1	4.1	0.71
MF-GO	22.3	2.6	20.1	3.4	0.09
S-GO	47.2	5.6	43.5	3.7	0.09
MF-I	37	4.6	34.2	4	0.14
MF-H	35.8	3.7	34.7	4.9	0.56
H-GO	60.5	12.4	59.5	5.2	0.81
GO-M	44.6	2.3	43.7	2.6	0.4

Table 3. Radiographic measurements of the 21-25 age cohorts.

	Morphology		Radiograph		
Right	**Mean**	**SD**	**Mean**	**SD**	**Sig**
MF-P	13.3	1.9	9.1	2.4	0.00
MF-A	18.4	2.7	11.2	1.9	0.00
P-A	32.4	4.6	22.2	2.8	0.00
MF-S	20.6	3.1	23.8	4.7	0.01
MF-GO	22.6	3.5	21.3	3.1	0.51
S-GO	43.2	4.9	46.5	5.8	0.68
MF-I	35.3	3.8	36.9	4.7	0.24
MF-H	39.5	4.1	38.2	4.3	0.33
H-GO	49.5	7.3	63	5.4	0.00
GO-M	106.5	5.2	44.5	2.4	0.00
Left	**Mean**	**SD**	**Mean**	**SD**	**Sig**
MF-P	13.3	2.1	8.1	1.8	0.00
MF-A	18.3	2.2	11.4	2.1	0.00
P-A	33.4	3.6	22.2	3.5	0.00
MF-S	20.5	3.3	22.5	3.3	0.58
MF-GO	21.8	3.7	21.5	3.1	0.60
S-GO	42.6	4.8	45.8	5.2	0.02
MF-I	35	4	36	4.5	0.52
MF-H	38.9	3.5	35.4	4.1	0.02
H-GO	47.6	7.2	60.1	10.1	0.00
GO-M	106.5	5.2	44.3	2.4	0.00

Table 4. Comparison between the mean measurements of the radiograph and the morphometric.

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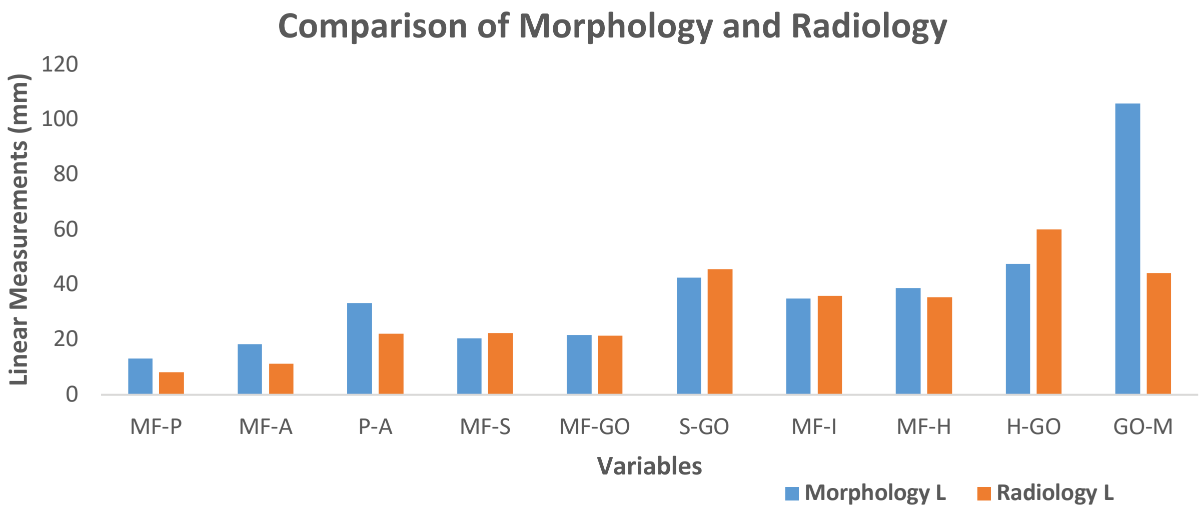

Figure 6. Comparison between the means for the radiographic and morphometric measurements in the age cohort 21-25 on the left side of the mandible.

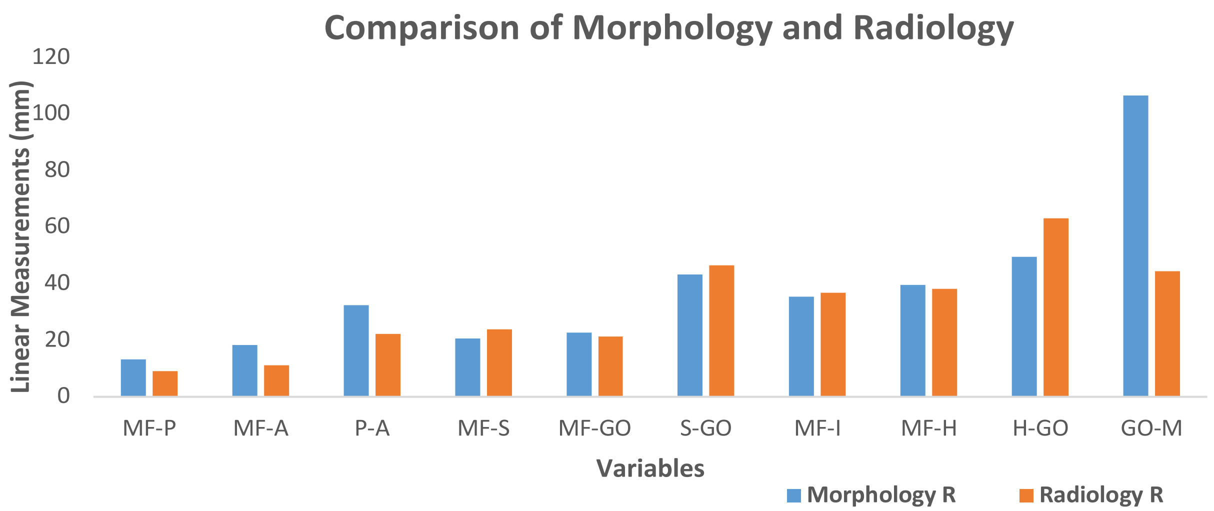

Figure 7. Comparison between the means for the radiographic and morphometric measurements in the age cohort 21-25 on the right side of the mandible.

DISCUSSIONS

Considering the results of morphometric analysis of the current study, all parameters increased with increasing age except MF-A distance, however, the difference was not statistically significant. The results of this study showed that MF is situated more towards the superior border of ramus of mandible than the inferior border. These results were similar to results by Mbajiorgu, 2000; and Shalini et al., 2016 but differed from results of Alves and Deana 2014; and Samanta and Kharb, 2013 which described position of MF to be more towards inferior border of ramus of mandible[1,4,9,13].

Analysis of Anterior-Posterior Dimension of Mandible (MF-A and MF-P)

Anterior-posterior (A-P) dimension of mandible showed the mean of MF-P on both left and right sides to be significantly less than mean of MF-A. The mean of MF-A on right and left were 18.8mm and 18.9mm respectively whereas the mean of MF-P was 13.7mm and 13.4mm on right and left respectively. This suggests that position of MF on dry bones was more towards the posterior border of ramus of mandible than towards anterior border.

The outcomes of this study were similar to that of Alves and Deana (2014); Marzola et al., (2005); Mbajiorgu (2000); Shalini et al., (2016); and Thangavelu et al., (2012), but differs from results by Samanta and Kharb, 2013 which described MF to be at a mean distance of 15.72mm and16.23mm on right and left from the anterior border of ramus of mandible respectively; and at a mean distance of 13.29mm and 12.73mm on right and left from posterior border of ramus of mandible respectively. Although there was a difference in Samanta and Kharb's study (2013), a similar pattern of MF being situated more towards posterior border of ramus of mandible was still observed.

MF-A and MF-P parameters suggested that MF was located more towards posterior border of ramus of mandible. However, these finding were contrary to findings by Trost et al., (2010) which considered posterior border of mandible as "safety zone" where MF is unlikely to be found.

Alves and Deana, (2014) reported that MF is slightly higher in ramus of mandible of younger individual because a statistically significant difference was observed in MF-S distance between younger groups and other groups aged 31-45, 46-60 and 61 years. The authors also reported an ethnic statistically significant difference in mean values of MF-A between white and African individuals. The mean value of MF-A was higher in African individuals than in white individuals.

Analysis of Inferior-Superior Dimension

MF-GO distance was recorded as 22.9mm and 22.7mm on right and left respectively. MF-S was shown to be 20.1mm and 20mm on the right and left sides respectively. There

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was no statistically significant difference between left and right side for both MF-S and MF-GO parameters. Our results show that MF is situated more towards superior border of ramus of mandible than inferior border. These results were similar with results by Mbajiorgu, (2000) and Shalini et al., (2016). Albeit the results of Alves and Deana (2014) and Samanta and Kharb, (2013) described the position of MF to be more towards inferior border of ramus of mandible.

Analysis of MF-GO

Singh et al., (2015) reported on location of MF with respect to GO angle. They stated that mandible undergoes substantial morphological and dimensional changes, therefore, the dimensions vary with age and state of dentition. They attributed these changes to action of muscles of mastication. Singh et al., (2015) found a strong negative correlation between GO and distance of MF from angle of mandible, suggesting that a decrease in GO correlates with an increase in distance of foramen from angle of mandible. The authors noted that the mean GO varies in different racial populations and decreases with age. Our study noted that a decrease in GO correlates with a decrease in angle of mandible.

Analysis of MF-I and MF-H

The average distance of MF-H was shown to be 39.3mm and 39.1mm on the right and left sides respectively. MF-I was recorded as 35.3mm and 35mm on the right and left sides respectively. Marzola et al., 2005 examined the position of MF in relation to condyle and reported that MF was positioned at 21mm from the top of condyle on both left and right sides. However, only thirty mandibles were used in their study, of which sex and age were unknown. MF-I was not measured in their study; therefore, a comparison between those parameters could not be ascertained.

Analysis of Mandibular Ramus (PA)

The total width of mandibular ramus demonstrated no significant difference between left and right sides. Our results were similar to results by Oguz and Bozkir, (2002); Shalini et al., (2016); Thangavelu et al., (2012) and Padmavathi et al., (2014). However, our results demonstrated that the mean value of P-A distance was significantly greater in males than in females ($P<0.001$) on both left and right sides.

Analysis of S-GO

The average distance from sigmoid notch to inferior border of ramus of mandible in our study was recoded to be the same on both left and right sides, with average distance of 43.2mm and 43mm on both right and left respectively. There was no statistically significant difference noted between left and right sides. However, our results demonstrated significant difference between males and females which was similar to Padmavathi et al., (2014) and Thangavelu et al., (2012) findings.

Sexual Dimorphism in the Location of MF

Males demonstrated greater readings in most parameters than females. About 80-90% of parameters in our study showed statistically significant difference between males and females. Alves and Deana, (2014) reported that MF-S value in African females was significantly higher than in white females, while in males, mean values for Africans and whites were similar. Shiny Vinila et al., (2017) found that variable distance from MF to anterior borders of ramus of the mandible was found to be mostly dimorphic for sex determination followed by distance between MF to inferior border of mandible by using discriminative function analysis test. Furthermore, the study was able to determine sex (gender variation) of isolated mandible with 90% accuracy by using distance from centre of MF to borders of ramus of the mandible. Jambuhath et al., (2016) used two methods; the ramus method in which measurement of ramus height and breadth were used and gonial method in which measurements of gonial angle and bigonal width were measured. They reported that, in the ramus method, condylar, coronoid and projection of height of ramus were higher in males, whereas, in gonial methods, gonial angle was higher in females. Though both methods were not different, both can be used for sex determination. The ramus method has proved to be more accurate than the gonial method.

Location of the MF in relation to Age

The location of MF also varies with age. Kilarkaje et al., (2005), found that the distances from MF to all various landmarks were shortest in young individuals and longest in adults. They concluded that location of MF maintains absolute bilateral symmetry in human mandibles, regardless of age. Trost et al., (2009) suggested that MF was always situated in ventral and inferior two-thirds of ramus without difference according to side, sex or age. Ashkenazi et al., (2011), conducted a study to determine the location of MF in anterior-posterior dimension in primary, mixed and permanent dentition of dry mandibles of Israelis and correlated these changes with size of gonial angle. They found out that MF are located in the 3rd quarter of ramus in A-P dimension, and it shifts anteriorly with age. The gonial angles decrease with age and with changing dentition from mixed to permanent dentition. Keros et al., 2001 studied the variability in position of MF which could be responsible for the occasional failure of IANB anaesthesia in Croatians patients. They found no significant difference in sex and age among patients involved in the study.

Location of MF in Relation to Occlusal Plane and Ethnic Differences

Shukla et al., 2018 conducted a study aimed to correlate position of MF with occlusal plane as a clinical guide for inferior alveolar nerve block (IANB) injection in children aged 3-13 years using panoramic radiographs. They concluded that the bony landmarks within the jaws keep changing their position along with skeletal growth, thus the gonial angle values decreases with increasing age. Therefore, it was suggested that the needle for IANB should be placed below the occlusal plane in 3-4years old children (1.26mm approximately), almost at the level of occlusal plane in 5-7years old (0.33mm), above occlusal plane in 7-9 years (1.54mm), 9-12years (1.64mm), 11-12years(1.98 mm) and 12-13years (2.9mm) olds respectively. Thangavelu et al., (2016) noted that MF is situated at or below occlusal surface of mandibular teeth and without significant difference between right and left side. Their results showed that MF was situated at 2.75 mm posteriorly from midpoint of width of ramus and 3 mm superiorly from midpoint of vertical height (between sigmoid notch and inferior border). Nicholson, (1985) found MF to be below the occlusal plane of mandibular teeth in 75% cases, and at occlusal plane in 22.5% cases of East Indian ethnic origin.

Mbajiorgu, (2000), while examining anatomical specimens of adult black Zimbabweans, stated that position of MF was

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individualistic due to wide range variations in measurements of individual mandibles and that there was no sex variation of position of the foramen. It was found position of MF was at the same level as occlusal plane in 47.1 % of specimen studied, 29.4 % of specimen had MF above the occlusal plane, while 23.5% was below the occlusal plane and on average lies at about 2.56 mm (Right) and 2.08 mm (Left) behind mid-point of ramus width. There was a bilateral symmetry in position of MF. While Aglarci et al., (2015) found MF located just anterior-superior to the midpoint of ramus and below occlusal plane in Turkish populations, they also reported a significant difference for location of MF among males and females.

Hoque et al., (2013) found no significant difference in values from both sides of Bangladeshi dry adult human mandibles; therefore, MF was at the same distance from each landmark on both sides of mandible demonstrating symmetry. Russa and Fabian, (2014) found MF to be above occlusal surface of first mandibular molar (about 10mm above the occlusal plane) and above occlusal surface of second premolar (about 14mm above the occlusal plane). They also found MF to be located about 20 mm and 12 mm from anterior and posterior borders of ramus respectively, meaning that MF was located more frequently on posterior half of ramus of mandibles in adult black male Tanzanians aged 35- 45 years population.

Radiographic Component

In our study, the right side showed significant difference between males and females in MF-GO; S-GO; MF-I and H-GO parameters. Contrary to left side, a significant difference was noted on MF-A parameter only. Males showed higher readings than females in all parameters except for MF-P distance (figure 7); however, these findings could be biased because more male specimens than females were used. The mean value of MF-A distance on both left and right showed higher readings than mean of MF-P distance in both males and females (figure 7). MF-A was recorded to be 11.5mm and 12.3mm on both right and left sides respectively in male population. In females, it was recorded to be 10.9mm and 9.9 mm on both right and left sides respectively. MF-P distance was recorded to be 8.8mm and 7.9mm on both right and left sides respectively in male population whereas in female population, it was recorded to be 9.6mm and 8.5mm on both right and left sides respectively. Furthermore, MF was noted to be more towards the posterior border of ramus of mandible. These results were aligned with morphometric results of our study suggesting a possible correlation in the studied distance. In a study by Park and Lee (2015), the findings were significantly greater than findings of our study. However, the pattern of their MF-A findings aligned with those of morphometric and radiographic analyses in the current study. Males showed greater readings than females; however, no statistically significant difference was noted between males and females. They also confirmed that the average radiographic distance of MF from mandibular notch differs with different occlusions.

Conclusion

MF-A distance was constantly greater than MF-P distance suggesting that MF is situated more in posterior than anterior region of the mandible. The comparison between radiographic and morphometric analysis showed no significant difference in most parameters. This outcome confirms a correlation between morphometric and radiographic measurements, reemphasizing the importance of preoperative CBCT radiographs to minimise injuries to IAN bundle. Therefore, anterior border of ramus of mandible can be regarded as “safety zone” during surgical procedures among South African black population.

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Conflict of interest

The authors declare that they have no conflict of interest related to any aspect of this research project.

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