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Research Article

Analysis of Average Index Values of Mandible

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Abstract

Objectives: Mandible is the only viscerocranium bone moving in the skull. Mandible is active in speech and chewing functions; important bone for many areas such as anatomy, dentistry, anthropology, plastic and reconstructive surgery, jaw surgery. The aim of this study is to determine the average index values of the mandible and to contribute to the literature.

Methods: This study was carried out using digital calipers with a sensitivity of 0.01 millimeter (mm) on 15 mandibular dry bone specimens in Anatomy Department of Erciyes University. Age and gender were not differentiated in dry bone samples. Measurements were made on the mandible, mainly on the location of the mental foramen and mandibular foramen, and on the other 20 reference points of the mandible.

Results: In our study, there was no statistically significant difference when bilateral mandible data were compared ($p>0.05$). The average length of the mandibular foramen to the deepest point of the mandibular notch was found to be 20.39 mm on the right and 19.90 mm on the left.

Conclusion: Knowing the normal anatomic structure and morphometric values of the mandibular bone well may avoid any possible complications during operations in this area.

Keywords: Mandible, mandibular foramen, mental foramen, morphometry

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Besides the functions such as chewing and speaking, the aesthetically important mandible; He has always been interested in many clinical branches such as anatomy, anthropology, plastic and reconstructive surgery, jaw surgery, otolaryngology surgery, and dentistry. Especially in recent years, the clinical importance of the mandible has increased in order to meet the functional and aesthetic needs of the increasing treatment methods.

During the formation of the mandible, this bone is in two parts, right and left. In the anterior mid-section of the corpus of the two sides of the corpus is called the symphysis mandibulae.[1] In the sympathetic mandible region formed by the two corpus unions, the mandible becomes a single bone.[2] The mandible is a U-shaped bone with teeth on it.[3] The mandible is the largest and only movable bone of the skeleton. Os mandibulae open the contents of the teeth, horizontally arranged with the corpus mandibulae at the rear of the two pieces of ramus mandibulae. The corpus mandibulae, the body of the mandible, is similar to a horseshoe.[4,5] The hole in the middle of the inner face is called the foramen mandibulae and canalis continues in the mandibulae. A portion of the canalis mandibulae, which ends with a foramen mentality that is the hole in the lower part of the outer 2nd premolar, is also found in the corpus mandibulae.[1] Foramen mentale. a.v.n. mentalis passes.[6]

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Corpus mandibulae prolongs and expands during development.

The mandible completes the development by first showing expansion. Then, respectively, the longitudinal and height improvements are completed. The first 2-year rapid development after birth is followed by a lower rate between 3-6 years of age.[7] The size and evaluation of the mandible is important for the implants to be applied to the mandible. Implant surgery aims to restore aesthetics by providing adequate chewing and speaking function. It is important to investigate the relationship between bone size and morphology, location of the foramen mentale and canalis mandibulae, as well as other important anatomical structures, as well as determining the location, height and width of the mandible for preoperative planning.[8]

Nervus alveolaris inferior originates from the fifth head nerve called trigeminus. N. trigeminus is the largest head pair nerve and contains both motor and sensory branches. The Nervus trigeminus starts as radix sensoria and radix motoria on the anterior aspect of pons and passes the posterior fossa crania to the fossa crania media and passes over the upper part of the apex partis petrosa which belongs to os temporale. He is responsible for the motor innervation of chewing muscles while receiving senses from most of the head. There are three major branches of N. trigeminus, n. ophthalmicus, n. maxillaris, n. It is mandibularis`. N. alveolaris inferior, n. mandibularis is one of the posterior root branches and moves from the foramen ovale to the foramen mandible. M. pterygoideus passes through the medial of the lateralis and then passes between the ligamentum sphenomandibulare and ramus mandibulae into the canalis alveolaris inferior.[1,9] Foramen mentale. a.v.n. mentalis passes. Accurate determination of the anatomical position of Foramen mental is very important in periodontal surgery, flap surgery of lower teeth, retrograde amalgam filling application, surgical orthodontics and surgery of lower lip. N. mentalis injuries can cause temporary or permanent sensitivity, temperature and tactile changes in the regions of innervation.[6] Dentists often use n. alveolaris inferior blockade in invasive procedures related to the teeth in the mandible. In this application, the anesthetic agent is injected around the foramen mandibulae and if the nerve block is successful, all the teeth in the mandibula correspond to the median plate. The sensation loss is observed in the jaw and lower lip, which is innervated through the nerve mentalis and ramus incisivus, which are the branches of N. alveolaris inferior. The anatomical location and morphometry of the foramen mandibulae through which the nervus alveolaris inferior passes are very important in the anesthesia applications of the mandible. However, if the injector is advanced too far posteriorly during injection, gl. parotidea (parotid gland) can cause damage and unilateral functional paralysis in the branches of the nerve facialis can create.[3] Good knowledge of the normal morphology, dimensions, angles, channels and physical characteristics of the mandible may be clinically important to prevent complications that may occur during and after surgical procedures.

In this study, it is aimed to make detailed morphometric measurements on mandibular bones. Most of the anatomical parameters that should be considered during surgical interventions have been described and it is thought that these measurements will help surgeons to perform successfully and anesthesia.

Methods

The measurements were made by using a digital caliper measuring 0.01 millimeters (mm) on 15 mandible bones in the anatomy laboratory of Erciyes University Medical Faculty. Age and gender were not differentiated when selecting mandibula bones to be used. Both sides data were measured symmetrically and fractures, pathology and wear from the mandibular bones were not included in the study.

Measurement Variables

1. Distance from the deepest point of the inner edge of the foramen mandibulae to the deepest point of the incissura mandibulae
2. Distance from the deepest point of the inner edge of the foramen mandibulae to the most protruding point of the angulus mandibulae
3. Distance from the deepest point of the inner edge of the foramen mandibulae to the inner corner of the upper edge of the caput mandible.
4. The length of the line leading from the deepest point of the inner edge of the foramen mandibulae to the rear edge of the ramus mandibulae
5. The length of the line leading from the deepest point of the inner edge of the foramen mandibulae to the ramus mandibulae leading edge (linea obliqua)
6. The length of the line leading from the deepest point of the inner edge of the foramen mandibulae to the lower edge of the corpus mandibulae
7. Foramen mentale with the distance between the symphisis mandibulae
8. Distance of foramen mentale with the between the other side foramen mentale
9. Distance between the foramen mentale and the lower edge of the corpus mandible
10. Distance between the foramen mentale and the ramus mandibular posterior edge
11. Distance between the foramen mentale and the upper

edge of the corpus mandible
12. Distance of between processus condylaris and gonion
13. Distance of between processus coronoideus and caput mandibulae (processus condylaris)
14. Distance of between caput mandibulae and gnathion
15. Height of symphisis mandibulae
16. Processus coronoideus with the distance between the other side processus coronoideus
17. Distance of caput mandibulae (processus condylaris) with the between the other side caput mandibulae (processus condylaris)
18. Distance between tuberculum mandibulae with foramen mentale

The results are recorded by one person in order to obtain the correct results and no differences due to the measurement person (Figs. 1-3).

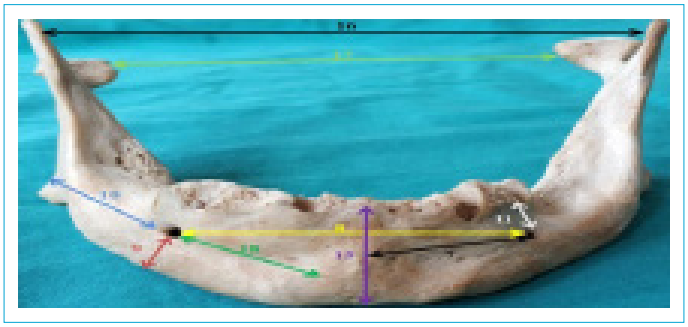

Figure 1. Front view of mandible.

Figure 2. Rear view of mandible.

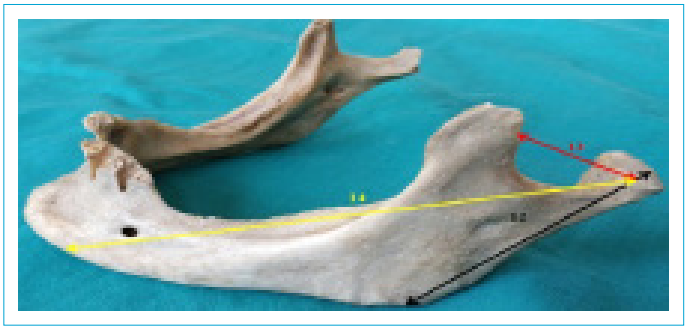

Figure 3. Side view of mandible.

Results

When the data obtained from bilateral mandible bone were compared, no statistically significant difference was found ($p>0.05$). The mean length between the foramen mandibulae and the deepest point of the incissura mandibulae was 20.39 mm on the right and 19.90 mm on the left. The distance between the processus condylaris and gonion was recorded as 57.39 mm on the right and 56.69 mm on the left. The distance between the foramen mentale and the tubercle mentale was 19.55 mm on the right and 19.86 mm on the left (Tables 1 and 2).

Discussion

Clinical findings such as tumor, inflammatory disease, fractures and jaw lesions in the mandible can be evaluated in detail and we can get information about cortical nerve and tooth roots and neighborhoods. Good knowledge of the normal morphology, angle, number, size, location and direction of the mandible and the physical characteristics of the mandible are important in terms of revealing cosmetic and functionally acceptable results in mandibular reconstruction. Recently, mandibula implant placement applications and endodontic treatment of bone size and morphology, foramen mentality, foramen incisivum and canalis mandibulae 's location, height and width determination, important anatomical structures have gained importance.[8] The localization of the foramen mentality, the diameter and the detection of the accessory mental foramina can be ignored in radiographic panoramic and periapical radiographs. CT provides superiority and reliability in facial bone imaging according to radiographs.[11,12] Rastogi et al.[13] (2012) reported that the results of this parameter were lower than other studies because of epigenetic differences.

Accessory foramen mentality is a rare anatomical variation. Rouas et al.[14] (2007) reported that panoramic radiographs were inadequate in the diagnosis of canalis mandibulae and foramen mentality variations. In many studies, it has been reported that aging of the teeth increases with gonial angle in aging individuals.[15–17]

Aksu et al.[18] 6 different measurements were made on the foramen mandibulae using 102 mandibulae bone. The distance between the foramen mandibulae and the caput mandibulae, the ramus mandibulae, the leading edge of the ramus mandibulae, the lower edge of the corpus mandibulae, the incisura mandibulae, and the angulus mandibulae were measured. It was reported that the mean values of the foramen mandibulae and incisura mandibulae at the deepest point of the mandibulae and the most protruding distance between the angular mandibulae were significantly different. Aksu et al.[18] In their study, the length of

Table 1. Parameters of the mandible

Parameters	Min. Distance (mm)	Max. Distance (mm)	Average (mm)	STD
For. man.-inc. man.	16.07	25.43	20.15	2.61
For. man.- angulus man. most protruding point	11.65	28.71	20.76	4.02
For. man.-caput man.	27.31	43.86	34.28	4.90
For. man.-ramus man. posterior between	7.66	15.50	11.40	1.89
For. man. - ramus man. leading edge	8.51	20.86	14.24	3.21
For. man.-corpus man. lower edge	19.18	30.80	24.33	2.68
For. ment.-symphisis man.	21.64	29.96	27.09	2.14
For. men.-corpus man. upper edge	8.50	17.79	12.34	1.96
For. men.-ramus man. posterior edge	53.13	67.67	60.34	4.66
For. men.-corpus man upper edge	3.74	14.82	9.07	2.96
Proc. cond.-gonion	50.24	64.22	57.04	4.17
Proc. cond.-caput man.	21.14	31.79	27.21	2.49
Caput man.-gnathion	81.26	129.11	103.97	17.25
Proc. cond.-gnathion	64.17	107.17	85.15	15.16
İnc. man. depht	3.34	13.72	10.38	2.46
For. men.-tuberculum men.	12.86	24.90	19.70	2.79
For. mentaleler distance between	34.60	46.82	42.61	3.25
Caput man. distance between	102.97	129.09	113.55	8.01
Proc. condylarisler distance between	80.56	107.41	93.53	7.65
Symphisis man. height	19.35	31.36	25.67	3.93

Table 2. Reference points in mandible

Reference locations	Average (mm)	STD
For. mandibulae- inc. mandibulae		
Right	20.39	2.36
Left	19.90	2.90
For. mandibulae- angulus mandibulae		
Right	20.86	3.88
Left	20.66	4.30
For. mandibulae- caput mandibulae		
Right	34.68	5.18
Left	33.88	4.75
For. mandibulae- ramus mandibulae posterior edge		
Right	11.33	2.14
Left	11.47	1.67
For. mandibulae- ramus mandibulae leading edge		
Right	14.34	3.38
Left	14.15	3.15
For. mandibulae- corpus mandibulae lower edge		
Right	24.29	2.33
Left	24.36	3.07
For. mentale- symphisis mandibulae		
Right	27.05	2.26
Left	27.13	2.10
For. mentale- corpus mandibulae lower edge		
Right	12.31	2.17
Left	12.38	1.79
For. mentale- ramus mandibulae posterior edge		
Right	60.14	5.02
Left	60.55	4.44
For. mentale- corpus mandibulae		
Right	9.13	2.94
Left	9.00	3.08
Proc. condylaris- gonion		
Right	57.39	4.43
Left	56.69	4.01
Proc. condylaris- caput mandibulae		
Right	27.01	2.51
Left	27.41	2.55
Caput mandibulae- gnathion		
Right	103.56	17.58
Left	104.38	17.53
Proc. condylaris- gnathion		
Right	85.05	15.82
Left	85.24	15.02
İnc. mandibularis depht		
Right	10.46	2.67
Left	10.31	2.33
For. mentale- tuberculum mentale		
Right	19.55	3.10
Left	19.86	2.54

the foramen mandibulae ramus mandibulae leading edge is approximately 12.81 mm and the distance to the rear edge is 14.45 mm. Salbacak et al.[19] According to the study performed by the foramen mandibulae ramus mandibulae an average length of 16 mm from the front edge of the ramus mandibulae reported as 14 mm from the back edge. In our study, the length of the foramen mandibulae to the anterior edge of the ramus mandibulae was found to be 14.24 mm and the length between the ramus mandibulae was 11.40 mm. The distance of the foramen mentale to the symphysis mandibulae 25.3 mm on the right, 25.2 mm on the left was reported by Salbacak et al., 25.73 mm on the right, and 30.74 mm on the left was reported by Kökten et. Al. (2004), 25.98 mm in the right, 26.3 mm in the left was reported by Lopes et al. (2010), in the study by Agarwal et al. (2011) 25.55 mm in the right, 25 mm in the left, on the right 26.08 mm, on the left 26.15 mm Rastogi et al. (2012) reported.[13, 20–22] The data obtained from the study conducted by Direk (2014) on mandible measurements using multidetector computed tomography revealed 24.44 mm on the right, 24.86 mm on the left, 25.39 mm on the right and 26.31 mm on the left. In our study, the distance from the foramen mentale to the symphysis mandibulae was 27.05 mm on the right and 27.13 mm on the left. In a study by Wang et al. (1986), measurements were performed on cadaver and found to be 28.06 mm on average.[24] The distance of the foramen mental to the ramus mandibular back edge 66.1 mm on the right, 66.33 mm on the left reported by Salbacak et al. (1993), 66.5 mm on the right, 65.1 mm on the left reported by Kökten et al. (2004), 66.18 mm on the right, 66.2 mm on the left reported by Rastogi et al. (2012).[13, 21, 22] In the study conducted by Wang et al. (1986), measurements were performed on cadaver and found to be 74.14 mm on average. The data obtained from the study of mandibulae measurements by multidetector computed tomography by Direk (2014) revealed for man 66.98 mm on the right, 66.43 mm on the left, for women 72.36 mm on the right and 71.7 mm on the left.[23] In our study, the distance between the foramen mentale and the ramus mandibulae was 60.14 mm on the right and 60.55 mm on the left.

The distance of the foramen mentale to the upper edge of the corpus mandibulae 13.62 mm on the right, 14.29 mm on the left was reported by Oguz and Bozkır (2002), 14.05 mm on the right, 13.82 mm on the left was reported by Agarwal et al. (2011), 10.67 mm on the right, 10.71 mm on the left was reported by Rastogi et al. (2012).[13,22,25] The data obtained from the study conducted by Direk (2014) on mandible measurements using multidetector computed tomography revealed for women 13.43 mm on the right, 13.35 mm on the left, for man 14.76 mm on the right and 14.45 mm on the right. In our study, the distance from the foramen mentale to the upper edge of the corpus mandibulae was 9.13 mm on the right and 9 mm on the left.[23] The distance of the foramen mentale from the lower edge of the corpus mandibulae is 14.61 mm on the right, 14.29 mm on the left was reported by Oğuz and Bozkır (2002), on the right 13.41 mm, on the left 13.4. mm was reported by Kökten et al. (2004), 14.12 mm on the right, 13.55 mm on the left was reported by Lopes et al. (2010), on the right 12.16 mm, on the left 12.11 mm was reported by Agarwal et al. (2011), on the right 14.59 mm, on the left 14.64 mm was reported by Rastogi et al. (2012).[13,20–22,25] The data obtained from the study conducted by Direk (2014) in the study of mandibulae with multidetector computed tomography revealed for women 12.92 mm on the right, 12.90 mm on the left, for man 14.56 mm on the right and 14.24 mm on the left.[23] In our study, the distance of the foramen mentale from the lower edge of the corpus mandibulae was 12.31 mm on the right and 12.38 mm on the left.

Different from the studies we have done Kökten et al. (2004), Lopes et al. (2010), Rastogi et al. (2012), Ukoha et al. (2013) and the work done by Direk (2014) in the thesis of the foramen mentale was measured in the distance from the teeth.[13,20,21,23,26] There are also studies in the literature regarding measurement of gonion angle, measurement of angle between procesus condylaris and procesus coronoideus.[23] The height of the symphysis mandibulae 29.63 mm was reported by Vaishali et al. (2011), 29.63 mm was reported by Kumar and Lokanadham (2013).[27,28] In our study, the height of the symphysis mandibulae was found to be 25.67 mm.

Şahiner et al.[29] (2007) by skull bone geometric morphometry method in the study to determine the gender of the ages of 15 and 17 12 male and 13 female students participated voluntarily. The skeleton has a very important place in the determination of gender from the bone. According to the breeds such as sex, differences can be made by looking at the differences in the structures on the bones. Glabella can be examined for gender discrimination. If the glabella is flat and smooth, it can be understood that the female belongs to the male if it is more rough. It is also stated that a factor that is important in gender determination is associated with ramus flexure on the ramus mandibulae.[29] Although ramus flexure is observed in 85% of males, it is stated that this rate is 15% in females. Loth and Henneberg (1996) reported that ramus flexure could not be a decisive factor because it was not under 20 years of age. In a study by Loth and Henneberg (2001), it was reported that the mandibulacei was square or dot in males and more rounded in females. In our study, morphometric analyzes were performed without gender discrimination.[30] Hu et al.[31] (2006) reported that the mandible is

larger than other skull bones and is an important bone in terms of gender and race. It was reported that the male mandibula was larger than the female mandible and the chin was more protruding.

Conclusion

In this study, it is aimed to make detailed morphometric measurements on mandibular bones. Most of the anatomical parameters that must be considered during surgical procedures are described. In our study, no significant difference was found between the unilateral and bilateral measurements on the mandibular bone ($p>0.05$). In some studies, because of the data obtained from the computed tomography, the gender differences were calculated and bone measurements were calculated. The deformations, fractures, abrasions, bones without pathology were randomly chosen so as not to change the measurement results. These measurements could be done by making the sex determination while choosing the bones. In other studies, the length of the canalis mandibulae can also be measured by means of a wire. We believe that these measurements will help surgeons to perform a successful operation and anesthesia, and hope that they will serve as an example of new studies with mandibular.

Disclosures

Ethics Committee Approval: This study was carried out on dry bone samples in the Anatomy Department of Erciyes University Medical School. Ethical approval for dry bone samples is not given.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – S.Y.; Design – S.Y., A.T.; Supervision – S.Y.; Materials – A.T., M.T., S.A.; Data collection &/or processing – M.D., D.U., D.P.; Analysis and/or interpretation – A.T., M.T.; Literature search – M.D., H.S.; Writing – A.T., M.T.; Critical review – S.Y., A.T.

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