

## ORIGINAL ARTICLE

# A New External Landmark for Mental Foramen

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## ABSTRACT

**Purpose:** The purpose of this study was to establish a new external landmark of mental foramen to help facilitate prediction of the location during local anesthesia and during surgery of mandibular region.

**Materials and methods:** One hundred and ten adult Thai cadavers of 61 males and 49 females from Department of Anatomy, Faculty of Science, Mahidol University were included in this study. The anatomy of mental foramen in 110 adult Thai cadavers (220 sides) was studied from 2008 until 2011. Measurements in vertical plane were made: (i) From gingival sulcus to mental foramen = A, (ii) from mental foramen to inferior border of mandible = B, and (iii) the ratio of  $A/A + B = D$ .

Measurements in horizontal plane were also made: (i) From symphysis menti to the mental foramen = S (in straight line and not related to mandibular curvature), and (ii) from symphysis menti to the mental foramen = C (in curved line related to mandibular curvature), and (iii) in relation to position of lower tooth/teeth, and (iv) in relation to cheilions (corners of the mouth).

**Results:** The results included 61 male and 49 female cadavers. On the right side, the proportion of  $A/A + B (D)$  of male and female was 0.50 and 0.46. On the left side, the proportion of  $A/A + B (D)$  of male and female was 0.50 and 0.46. The location of right and left cheilion was related with the position of mental foramen, mostly at center (male: 63.93 and 70.49%, female: 61.22 and 73.47%). If center  $\pm 0.3$  cm it was possible to find the mental foramen more easily than the point of the center (male: 95.08 and 91.80%, female: 87.76 and 93.88%). If center  $\pm 0.5$  cm, it could find the mental foramen more easily than the point of the center  $\pm 0.3$  cm (male: 98.36 and 98.36%, female: 95.92 and 97.96%).

**Conclusion:** The knowledge gained from this study is quite important, since it helps the surgeon to easily identify the mental foramen prior to surgery which is halfway between gingival sulcus and inferior border of mandible in vertical plane and at the cheilion position in horizontal plane.

**Keywords:** External landmark, Mental foramen, Cheilions.

**Source of support:** Nil

**Conflict of interest:** None declared

## INTRODUCTION

The mandible is the largest bone of the face with a curved horizontal body and two broad rami. Due to this curvature the interpoint mandibular measurements is difficult to identify directly on living persons or indirectly by using radiographic assessments. The results will be unacceptable with high percentage of false positive findings and false negative findings. Because of the anterior-posterior views,

a direct measure is difficult (not curvature with mandibular bone); hence, the distance from midline to mental foramen is not the actual length when compared with the measurement along mandibular bone curvature.

An alternative is to apply the more modern technic of X-ray computed tomography (CT), i.e. CT scan. Greenstein and Tarnow have found that CT scans provide more accuracy in detecting the mental foramen/foramina than conventional X-ray radiographs.<sup>1</sup>

Among Jordanians, Al-Khateeb, Al-Hadi Hamasha and Taha Ababneh studied panoramic radiographs and found that the most common position for the mental foramen was lower and between the mandibular premolar teeth (1st and 2nd lower premolars).<sup>2</sup> However, this result was consistent with others among Caucasian population studied by Neiva, Gapski and Lay Wang.<sup>3</sup>

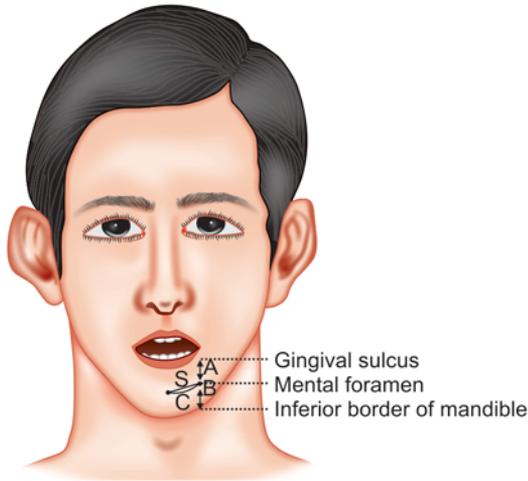
Among Thais, Apinhasmit, Chompoopong and Methathrathip found a mean measurement of  $28.52 \pm 2.15$  mm between symphysis and mental foramen, and also found that the mental foramen was commonly situated in line with the second lower premolar.<sup>4</sup> Wu-Chul Kim, Sun-Heum M and Doo-Jin studied in Chinese and found that  $16.56 \pm 2.53$  mm when measured from inferior alveoli to mental foramen, and  $15.56 \pm 1.74$  mm when measured from mental foramen to superior the bottom of the mandible.<sup>5</sup>

In this study, we would like to know the new external landmark for the mental foramen to be located easily and more practical for the surgeon when maxillofacial procedure is performed, e.g. genioplasty, chin plasty and implant placement.<sup>3</sup>

## MATERIALS AND METHODS

The subjects for this research consisted of 110 Thai cadavers: 61 male and 49 female adults at the Department of Anatomy, Faculty of Science, Mahidol University, Bangkok, Thailand. The anatomy of mental foramina and the mandibles was studied on 220 sides of 110 cadavers during 2008 to 2011. Measurements in vertical plane were made: (i) From gingival sulcus to mental foramen = A, (ii) from mental foramen to inferior border of mandible = B, and (iii) the ratio of  $A/A+B = D$ .

Measurements in horizontal plane were also made: (i) From symphysis menti to the mental foramen = S (in straight line and not related to mandibular curvature, measured with sliding caliber), (ii) from symphysis menti to the mental foramen = C (in curved line related to



**Fig. 1:** Technique used in the measurements: A—from gingival sulcus to mental foramen, B—from mental foramen to inferior border of mandible, C—from symphysis menti to the mental foramen (in curved line related to mandibular curvature as measured with a flexible ruler), D—the ratio of  $A/A + B = D$ , S—straight measurements from symphysis menti to the mental foramen (in straight line and not related to mandibular curvature as measured with a sliding caliber)

mandibular curvature, measured with flexible ruler), (iii) in relation to position of lower tooth/teeth, and (iv) in relation to cheilions (corners of the mouth) (Fig. 1).

**STATISTICAL ANALYSIS**

Results between genders and sides were compared and analyzed. Mann-Whitney U-test was used to compare differences of mean rank scores of A, B and D between genders and between right and left sides. Independent t-test was used to compare distances from mental foramen to symphysis menti between the two genders.

**RESULTS**

The results included 61 male and 49 female cadavers. At right side, the average length from gingival sulcus to mental

foramen (A) of male and female was 1.33 and 1.19 cm (SD = 0.32 and 0.37), the average length from mental foramen to inferior border of mandible (B) of male and female was 1.33 and 1.37 cm (SD = 0.24 and 0.34), and the proportion of  $A/A+B$  (D) of male and female was 0.50 and 0.46 (SD = 0.07 and 0.09). On the left side, the average length from gingival sulcus to mental foramen (A) of male and female was 1.33 and 1.19 cm (SD = 0.32 and 0.37), the average length from mental foramen to inferior border of mandible (B) of male and female was 1.33 and 1.37 cm (SD = 0.24 and 0.34), and the proportion of  $A/A+B$  (D) of male and female was 0.50 and 0.46 (SD = 0.07 and 0.09) (Table 1).

Because of the non-normal distribution, the present study used Mann-Whitney U-test to compare the differences of mean rank scores of A, B and D between genders on the right side and left side. When comparing the mean rank scores of A and B between genders on the right side and left side, it revealed that there was no statistically significant difference between male and female ( $p > 0.05$ ). However, when comparing the mean rank scores of D between genders on the right side and left side, it revealed that the mean rank scores of male were higher than those of female ( $p < 0.01$ ) (Table 2).

The distance from mental foramen to symphysis of male and female at Rt MFS\_SM was 3.27 and 3.09 cm (SD = 0.29 and 0.28), the distance from mental foramen to symphysis of male and female at Lt MFS\_SM was 3.26 and 3.09 cm (SD = 0.27 and 0.28), the distance from mental foramen to symphysis of male and female at Rt MFC\_SM was 3.57 and 3.39 cm (SD = 0.29 and 0.30), and the distance from mental foramen to symphysis of male and female at Lt MFC\_SM was 3.57 and 3.40 cm (SD = 0.28 and 0.30). With regard to meeting the normality assumed, the present study used independent t-test to compare the distance from mental foramen to symphysis between genders. When comparing the mean scores of distance from mental foramen

**Table 1:** Mean and standard deviation of A, B and D of male and female cadavers on the right and left side

Position	Gender	N	Mean (cm)	SD	K-S test	p-value
Right A	Male	61	1.33	0.32	1.299	>0.05
	Female	49	1.19	0.37	1.483*	<0.05
Left A	Male	61	1.33	0.32	1.299	>0.05
	Female	49	1.19	0.37	1.483*	<0.05
Right B	Male	61	1.33	0.24	1.145	>0.05
	Female	49	1.37	0.34	1.588*	<0.05
Left B	Male	61	1.33	0.24	1.145	>0.05
	Female	49	1.37	0.34	1.588*	<0.05
Right D	Male	61	0.50	0.07	2.427*	<0.05
	Female	49	0.46	0.09	1.712*	<0.05
Left D	Male	61	0.50	0.07	2.427*	<0.05
	Female	49	0.46	0.09	1.712*	<0.05

Note: \*Non-normality; A: Length from gingival sulcus to mental foramen; B: Length from mental foramen to inferior border of mandible; D:  $A/A + B$ ; K-S test: Kolmogorov-Smirnov test

**Table 2:** Comparison of mean rank scores of A, B and D between genders on the right and left side

Position	Gender	N	Mean rank	Z	p-value
Right A	Male	61	60.39	1.811	>0.05
	Female	49	49.42		
Left A	Male	61	60.39	1.811	>0.05
	Female	49	49.42		
Right B	Male	61	55.58	0.031	>0.05
	Female	49	55.40		
Left B	Male	61	55.58	0.031	>0.05
	Female	49	55.40		
Right D	Male	61	62.60	2.764**	<0.01
	Female	49	46.66		
Left D	Male	61	62.60	2.764**	<0.01
	Female	49	46.66		

Note: \*\*p < 0.01; A: Length from gingival sulcus to mental foramen; B: Length from mental foramen to inferior border of mandible; D: A/A + B

**Table 3:** Comparison of distance from mental foramen to symphysis between genders on the right and left side

Location	Total (N = 110)		Male (n = 61)		Female (n = 49)		t-value	p-value
	Mean (cm)	SD	Mean (cm)	SD	Mean (cm)	SD		
Rt. MFS_SM	3.19	0.30	3.27	0.29	3.09	0.28	3.384**	<0.01
Lt. MFS_SM	3.18	0.29	3.26	0.27	3.09	0.28	3.174**	<0.01
Rt. MFC_SM	3.49	0.31	3.57	0.29	3.39	0.30	3.230**	<0.01
Lt. MFC_SM	3.49	0.30	3.57	0.28	3.40	0.30	2.987**	<0.01

Note: \*\*p < 0.01; MFS: Mental foramen measurement straight; MFC: Mental foramen measurement along curvature of the mandible; SM: Symphysis menti

to symphysis between genders at Rt MFS\_SM, Lt MFS\_SM, Rt MFC\_SM and Lt MFC\_SM, it revealed that the mean scores of distance from mental foramen to symphysis of male were higher than those of female ( $p < 0.01$ ) (Table 3).

The location of teeth on the right side and left side of both male and female was in the line with the second premolar, between the first and second premolar, and in the line with the first premolar respectively (Table 4).

The location of right and left cheilion related with position of mental foramen of male was central (63.93% and 70.49%), subsequently lateral and medial respectively, but the location of right cheilion of female was central (61.22% and 73.47%), subsequently medial and lateral, respectively, whereas the location of left cheilion of female was central, subsequently lateral and medial, respectively (Table 5).

**Table 4:** Location of tooth at the same level with mental foramen between genders on the right and left side

Gender	Location of tooth at right side				Location of tooth at left side			
	In the line with the first premolar	Between the first and second premolars	In the line with the second premolar	Total	In the line with the first premolar	Between the first and second premolars	In the line with the second premolar	Total
Males n (%)	12 (19.67)	24 (39.34)	25 (40.98)	61 (100)	11 (18.03)	24 (39.34)	26 (42.62)	61 (100)
Females n (%)	9 (18.37)	17 (34.69)	23 (46.94)	49 (100)	9 (18.37)	17 (34.69)	23 (46.94)	49 (100)
Total n (%)	21 (19.09)	41 (37.27)	48 (43.64)	110 (100.00)	20 (18.18)	41 (37.27)	49 (44.55)	110 (100.00)

**Table 5:** Location of cheilion in relation with the position of mental foramen in horizontal plane

Gender	Right cheilion				Left cheilion			
	Center	Medial	Lateral	Total	Center	Medial	Lateral	Total
Males n (%)	39 (63.93)	9 (14.75)	13 (21.31)	61 (100)	43 (70.49)	7 (11.48)	11 (18.03)	61 (100)
Females n (%)	30 (61.22)	10 (20.41)	9 (18.37)	49 (100)	36 (73.47)	4 (8.16)	9 (18.37)	49 (100)
Total n (%)	69 (62.73)	19 (17.27)	22 (20.00)	110 (100.00)	79 (71.82)	11 (10.00)	20 (18.18)	110 (100.00)

**Table 6:** Location of cheilion at center, center  $\pm$  0.3 cm and center  $\pm$  0.5 cm in relation with the position of mental foramen in horizontal plane

Gender	Right cheilion			Left cheilion		
	Center	Center $\pm$ 0.3 cm	Center $\pm$ 0.5 cm	Center	Center $\pm$ 0.3 cm	Center $\pm$ 0.5 cm
Males	39 (63.93)	58 (95.08)	60 (98.36)	43 (70.49)	56 (91.80)	60 (98.36)
Females	30 (61.22)	43 (87.76)	47 (95.92)	36 (73.47)	46 (93.88)	48 (97.96)
Total	69 (62.73)	101 (91.81)	107 (97.27)	79 (71.81)	102 (92.72)	108 (98.18)

The location of right and left cheilion was related with the position of mental foramen mostly at center (male: 63.93 and 70.49%, female: 61.22 and 73.47%, respectively). If center  $\pm$  0.3 cm it was found that the mental foramen was more than the point of the center (male: 95.08 and 91.80%, female: 87.76 and 93.88%, respectively), and if center  $\pm$  0.5 cm, the mental foramen was more than the point of the center (male: 98.36 and 98.36%, female: 95.92 and 97.96%, respectively) (Table 6).

## DISCUSSION

In this study, the vertical plane location of the mental foramen was found most commonly at halfway between gingival sulcus and inferior border of mandible. The mean distance from the mental foramen to the symphysis menti in this study was different from that in previous studies in Thai<sup>4</sup> and Chinese.<sup>5</sup> In horizontal plane, the mandible bone shape had curvature when measured along the curvature of mandible bone length more than measured straight. Male was longer than female, because female face has oval shape but in male it has square shape, most common in the same vertical plan with second premolar tooth which is the same as in a previous study.<sup>6</sup> The position of the mental foramen related to the tooth was variable among races,<sup>7-9</sup> but the most common position of the mental foramen in this study (44.55%) was in line with the long axis of the second lower premolar, which was in agreement with previous studies in Thais, Asians and Westerners.<sup>3,10-13</sup> The location of right and left cheilion was related with the position of mental foramen, mostly at center (male: 63.93 and 70.49%, female: 61.22 and 73.47%). If center  $\pm$  0.3 cm it was possible to find the mental foramen more easily than the point of the center (male: 95.08 and 91.80%, female: 87.76 and 93.88%). If center  $\pm$  0.5 cm, it could find the mental foramen more easily than the point of the center (male: 98.36 and 98.36%, female: 95.92 and 97.96%). This is different from the study Song and Wu-Chul,<sup>14</sup> who reported that, with reference to the soft tissue landmark, the mental foramen is located  $20.4 \pm 3.9$  mm inferior and  $3.3 \pm 2.9$  mm medial to the cheilions. Guo, Jing Li<sup>15</sup> studied location of mental foramen based on soft and hard tissue landmark in Chinese

population and found that the mental foramen is localized  $23.38 \pm 2.00$  mm inferior and  $3.55 \pm 1.70$  mm medial to the cheilions in front view, while  $23.53 \pm 2.11$  mm inferior and  $7.19 \pm 3.03$  mm posterior to the cheilions in lateral view.

## CONCLUSION

The knowledge gained from this study is quite important; since it helps the surgeon to easily identify the mental foramen prior to surgery. This is halfway between gingival sulcus and inferior border of mandible in vertical plane and at the cheilion position in horizontal plane.

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