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# Morphometric Evaluation of the Mental Foramen Using Cone Beam Computed Tomography in Different Facial Types.

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***Abstract***

***Introduction:*** *The anatomic location of the mental foramen is still a matter of debate. There are variations in the position of mental foramen in different populations. These variations indicate accurate detection of mental foramen position which result in safer dental procedures.*

***Aim:*** *To carry out a morphometric assessment of the mental foramen in patients with different facial types.*

***Material and Methods:****Ninety computerized cone beam tomographic scans from brachycephalic (n=30), dolicocephalic (n=30) and mesocephalic (n=30) facial types were used. Computerized cone beam tomographic scans were obtained using a Tomographic I Cat Unit and the Dolphin Imaging 11.0 Program. The mental foramen position was evaluated and compared in the three subgroups. The Bartlett and Shapiro-Wilk´s tests were used to evaluate the homogeneity of the variances. Influence of the three facial types on cephalometric measurements was evaluated using two way ANOVA and Tukey´s test. Correlationsbetweenage and some measurements of interest were assessed using Pearson´s moment correlation test*

***Results:****Mental foramen height was slightly smaller in females. Facial types influenced the following measurements: distance from the apex of the second lower bicuspid to the upper border of the mental foramen and distance from the lower border of the mental foramen to thelower border of the mandible. Statistical differences were observed betweenmesocephalic and brachycephalic subjects ($p<0.05$) and between mesocephalic and dolicocephalic ones ($p<0.05$). Mental foramen height was smaller in mesocephalic subjects ($p<0.05$). Mental foramenwidthwas smaller only in the left side in mesocephalic subjects. Distance between the buccal cortical and lingual cortical of the mental foramen was smaller in mesocephalic than in brachycephalic and dolicephalic subjects ($p<0.05$). A higher number of mental foramina were positioned between bicuspids and along the long axis of the second bicuspids: 74% and 20% respectively. An oval mental foramen was found more frequently: (80.6%) in mesocephalics; (77.4%) in brachycephalics and (86%) in dolicocephalics subjects. A circular shape was observed in 19%; 22%; and 13% in mesocephalic, brachycephalic and dolicocephalic individuals, respectively.*

***Conclusion:*** *Some measurements of the mental foramen may be different among facial type subjects. Distribution and shape of the mental foramen are similar in the three facial types.*

***Keywords:****Mandibular Nerve. Cephalometry.Cone-Beam-Computed Tomography. Anatomic Variations.*

## I. Introduction

The mental foramenis an opening on the lateral part of the mandible, where the inferior alveolar nerve branches into the mental and incisive nerves which are terminal branches supplying sensory innervation to the soft tissues to the buccalarea, lower lip and chin up to the mandibular midline[1]. Regarding shape, size, location and direction of opening, it is known that there are many anatomical variations in this foramen[2]. The inferior alveolar nerve bundle enters the lower jawthrough the mandibular foramen, passes along the mandibular canal and exits from the mental foramen as the mental nerve on the body of the mandible above the tubercleof the chin[3].Determining the precise location of the mental foramen is a key factor when considering placing dental implants or when surgical proceduresare planned in the foramenregion[4]. The precise location of such foramen is also important in some dental specialties including Operative Dentistry, Periodontics, Endodontics and OrthognathicSurgery, whenever a local anesthesia procedure is to be carried out[5-8].

In adults, the mental foramen islocated on average between 13mm and 15mm above the inferior mandibular border, but in adults presenting with bone resorption, the foramen is located closer to the alveolar crest and sometimes over it[9].One problem in determining the precise location of the mental foramen is that such a structure cannot be neither visualized nor palpated and thus, more advanced visualization techniques have to be used. The position of the mental foramen may be evaluated using periapical radiographs and conventional panoramic images[10].An additional problem in accurately identifying the mental foramen is the high percentage of false negatives. During surgical procedures, false findings may cause sensory disorders due to inferior alveolar nerve damage in the foramen area. Additionally, the foramen may also be confused with a radiolucent lesion in the apical area of the lower bicuspids[11]. These complex problems call for additional research using more sophisticated imaging techniques in these complex anatomicareas. The study of the mental foramen position has encouraged intense research in this area in the last few decades, as different dental specialties are involved and may benefit if anaccurate anatomic position of this foramen is determined. The precise location of the foramen is essential in some clinical procedures including bone block removal for bone grafts, treatment of bone fractures with plates, orthognathic surgery, and even when mini implants are used in orthodontics[12].

Mental nerve anesthesia is used as an alternative approach to alveolar nerve local anesthesia. When the mental foramen is injected, the anesthetic solution diffuses through the mental canal, which is very short (3-6mm), thus, the inferior alveolar nerve itself may be anesthetized and then painful sensation from lower anterior teeth, bicuspids, buccal gingiva, skin and mucosa of the mental and lower lip area isabolished[13]. The mental foramen presents a variety of anatomic and radiographic locationand actually the foramen may be located in any area between the lower canine and first bicuspid depending on some factors such as age and genre[14]. Cone Bean Computed Tomography has high spatial resolution exposures, provides an ideal form of imaging and allows a clear understanding of the anatomical relationship between structures in any anatomic complex area of the body[15]. Cone Beam Tomographyallows for an accurate morphometric analysis of the mental foramen, and thus, enables the clinician to develop a suitable treatment plan and to carry out a local anesthesia procedure without damaging the mental foramen[16].Radiographically, the mental foramen can be seen as a round radiolucent area in both the right and left sides of the mandible and conventional radiographs used in dental practice provide only a bidimensional image of a tridimensional structure. This problem prevents the observation of the mental foramen in some cases[17]. Because more studies are needed to depict the accurate location of the mental foramen, the aim of this study was to carry out a morphometric assessment of the mental foramen using Cone-Beam Computed Tomography in patients with different facial types.

## II. Material And Methods

### Sample

Ninety Cone-Beam Computed Tomographic views of acceptable image acquisition quality were selected from The Center of Radiology LeopoldoMandic University School of Dentistry. All tomographic scans were obtained using the same tomographic apparatus (TCFC-I-Cat, Imaging Science, Hatfield, PA). The exposure factors were customized to every patient with the following exposure factors: Field of view (FOV)=20 x 19 cm; Voxel size=0.25mm; exposure time= 20 seconds; Kpv=120; electric current=36mA.This investigation was approved by the Institutional Review Board and by the Ethical Committee of LeopoldoMandicUniversity School of Dentistry (Process Number 43173015.7.0000.5374).

Procedure: Each cone-beam tomographic image was allocated to three groups of 30 views each according to the facial type: brachycephalic, dolicocephalic and mesocephalic. The sample size was based in previous studies about this subject and published recently[7,18-19]Inclusion criteria in any of the three groups were as follows: both genres should be represented equally in the total sample, tomographic viewsshould be obtained only from subjects presenting exclusively with permanent dentition, subjects should not have history of orthodontic treatment, tomographic views should not present artifacts and the right and left mental foramens should be evaluated. Exclusion criteria were the following: patients with a history of orthodontic treatment before initial evaluation; presence of local pathology and/or systemic disease precluding tomographic assessment of the mental foramen; inaccurate tomographic images not allowing proper classification of the facial type, subjects reporting presence of a pathologic condition or syndrome and those participating simultaneously in another study, for instance, those participating in a "post-surgical follow up" investigation.

**Assessment of the facial type:**In order to evaluate the facial type, Rickett´scephalometricanalysis[20] and Vert´s index, were used. Cephalometrictracings were carried out on images generated from an i-CATtomographic cone-beam unit (Imaging Science, Hatfield, PA) and a Dolphin Imaging Software version 11.0. Cephalometric landmarks were marked in order to obtain a cephalometric tracing. The program records allcephalometric landmarks and proper sequence to obtain tracings displaying approximate visualization of any anatomic area of interest. When lines were traced between two or more landmarks, digital tracings were obtained together with linear and angular measurementsthatwere reported automatically. Standardization and tomographic measurement procedures to classify facial types were carried out by an independent observer blind to the goals of the study. This independent examiner carried out the classification of 30 selected tomographic images selected randomly and the same measurements were carried out 30 days later. Results were then analyzed in order to obtain the intra-examiner agreement level.

Following selection of the facial type, analysis was carried out into a dark room and measurements were carried by one previously trained examinerand in the computer of the same set ofequipment. The intra-class correlation testrevealed that intra-examiner reproducibilitywas excellent regarding both linear measurements (intra-class correlation>0.09 and p<0.0001) and nominal measurements (Kappa=1.0) obtained at two different times.

Once computed tomographic images were selected and allocated to three different groups based on the facial type:Mesocephalic (G1), Brachycephalic (G2) and Dolicocephalic (G3),computed tomographic images positioning was subjected to a process of standardization so as to select the scans to carry out the measurements. In this regard, planes and lines were adjusted. In the cases of the lower jaw, the median sagittal line was adjusted perpendicular to the ground and the base of the mandible parallel to the ground. In order to carry out this procedure, we used the Xoran Program (Xoran Technologies, USA). Each selected image was evaluated more than one time in both sides of the lower jaw and measurements were reported in mms, and based on the sequence as follows:

**a)** Apex of the second lower bicuspid to upper border of the mental foramen (Apc-UBMF);
**b)** Lower border of the mental foramen to lower border of the lower jaw= LBMF--LBman;
**c)** Mental Foramen Height (MFH);
**d)** Mental Foramen Width (MFW);
**e)** Buccal cortical to lingual cortical of the mental foramen (BCMF—LCMF);
**f)** Position of the mental foramen in relation to lower bicuspids;8
**g)** Oval shape ( ) circular shape ( )

## III. Data Analysis

Previously to use sophisticated statistical analysis, Bartlett´s and Shapiro-Wilk´s test were used to assess homogeneity of the variances and data distribution, respectively. Kruskal-Wallis´s test was used to evaluate for possible age differences in the three facial type groups. Genre differences were evaluated using Chi-square statistics, but age differences in both genres, were assessed using Mann-Whitney test. The influence of both genres on linear measurements was carried out using t-student test with or without Welch´s correction. Differences in the position of the mental foramen as compared to the position of the second lower bicuspid was evaluated using Chi – square test. A two way ANOVA with Tukey´s post hoc test was conducted in order to evaluate the influence of facial types on some specific measurements. Possible correlations between age and some specific variables were carried out using Pearson´ s correlation test. Significance was accepted in all tests if p<0.05. Statistical tests were carried out using Graph Pad Prism 6.0 and Bio Stat 5.0 software.

## IV. Results

Some cephalometric measurements were evaluated in brachycephalic, mesocephalic and dolycocephalic subjects. Mean ages in the brachycephalic, dolicocephalic and mesocephalic groups were about 17.1 (SD=3.1);16.2 (SD=3.8), and 15.9 (SD=4.5), respectively. Age was not statistically different in the three comparison groups (Kruskal-Wallis statistics p=0.81). There were 15 females and 15 males in the brachycephalic subgroup, 14 females and 16 males in the dolicocephalic subgroup and 10 females and 20 females in the mesocephalicsubgroup. There was no statistically significant difference when genre was compared (Chi-square statistics p=0.37). Thus, regarding age and genre, the sample was considered homogeneous (Table 1).

There was no positive correlation between age and any of the variables evaluated: Apex of the second lower bicuspid versus upper border of the mental foramen (Apc versus UBMF (Pearson´s rho =-0.03, p=0.67); lower border of the mental foramen versus lower border of the mandible (LBMF versus LBman, Pearsons´rho=0.05, p=0.49); mental foramen height (Pearsons´rho=-0.04, p=0.61); mental foramen width (Pearson´s rho=-0.06, p=0.44); buccal cortical versus lingual cortical of the mental foramen (BCMF-LCMF, Pearson´s rho= 0.01, p=0.87). See Table 2 for further details. Being female or male did not influence cephalometric measurements with the exception of the height of the mental foramen. This measurement was statistically significantly lower in females (p=0.0003). Thus, in general, age and genre did not influence the outcome significantly. See Table 3.

The position of the mental foramen as compared with the position of the second lower bicuspid as a function of sides and facial types is shown in Table 4. In general, there were predominantly a higher number of foraminapositioned between both lower bicuspids (about 74%, Chi-Square test p<0.0001) as compared with other anatomic positions. Additionally, the second most common position was accompanying the long axis of the lower second bicuspid (about 20% of the cases). There was neither influence of the right or left side nor of the facial type in the distribution of the anatomic location of the mental foramen(p>0.05). See Table 4 for further details.

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To observe a possible correlation among some measurements of interest, Pearson´s correlation coefficient test was used as shown in Table 5 (below). Although weak (Pearson´s rho=0.40, p value=0.1), there was a direct and significant correlation in all measurements ($p<0.05$), when facial types were considered as a whole. In this case, width and height of the mental foramendemonstrated a moderate correlation (Pearson´s rho=0.6, p=0.04). Segmenting data in different facial types strongly affected correlationsamong measurements, indicating a strong influence of the facial type in the relationship between sets of measurements. Thus, in brachycephalic individuals, there was no significant correlation between any pair of measurements, with the exception of the pair height-width of the mental foramen. Regarding mesocephalic individuals, there was only an inverse, significant but weak correlation between the measurements lower border of the mental foramen lower border of the mandible and mental foramen height (LBMF-LBMan-MFH), indicating that when one of this measurement increases, the other decreases. Regarding that facial type, there were no correlations when other measurements were compared.

Regarding dolicocephalic facial type, there was a direct correlation between the measurements height and width of the mental foramen and height of the mental foramen with buccal cortical and lingual cortical thickness of the mental foramen. This latter measurement also presented a positive correlation with Apex of de second lower bicuspid and upper border of the mental foramen (Apc-UPMF).Other correlations were found including those between the lower border of the mental foramen (LBMF)-lower border of the mandible (LBMand) with the apex of the second lower bicuspid (Apc)-Upper border of the mental foramen (UBMF) and with mental foramen width (MFW).Taken as a whole, these results show that the proportion between one measurement and the other varies largely with the facial type. See Table 5 for further details.We found that the most common shape of the mental foramen was oval in 81.3% of the cases in the three facial types. A circular mental foramen shape was observed in 18% of the whole sample.See Table 6.

## V. Discussion

The current literature emphasizes theclinical significance of the correct location of the mental foramen as it is closely related with the clinical success of numerous dental procedures, including, local anesthesia which carried out in a daily basis in the lower jaw in Restorative Dentistry, Endodontics, Periodontics, Pedodontics and in those moreinvasive procedures including Orthognathic Surgery, implant placement and many other procedures[6,8,12]. The Dental Surgeon should know that the mental foramen is subjected to some anatomic variations including those related to shape, size, number and changes related to vertical and horizontal positions. Further, this anatomic structure is usually confused with other pathologic lesions. It is for these reasons that many researchers[7,8,13], have emphasized the importance of evaluating its precise location using cone beam tomographic views. Additionally, studies about the mental foramen, have been carried out in a diversity of ethnic groups[6,21-29]; however, investigations relating facial types and the mental foramen, are extremely scarce, indicating the need for further research.

In the current investigation, we found that there was no statistically and significant difference in the groups regarding age and genre. Additionally, there was no statistically significant difference in age when comparing males (mean=16.2, SD=2.6 years) and females (mean=16.1, SD= 3.3 years. Although there was a higher number of males in the total sample (53=57.6%) as compared with females (39=42.4%), the difference was not statistically significant. Thus, regarding age and genre, the sample was considered homogeneous. There was no significant correlation between age and any of the morphometric variables we evaluated. Further, genre did not interfere with all measurements with the exception of the mental foramen height which was slightly less in females than in males. Thus, in general terms, both age and genre did not influence the outcome of the current study.

According to the current literature, the horizontal position of the mental foramen varies significantly in the region between canine and first molar. In the current study, the mental foramen position was more frequently observed between lower bicuspids (74%). This outcome is in line with manypreviousinvestigations[22,26,28-33], demonstrating a predominant location of the mental foramen between the first and second lower bicuspids. However, there is disagreement if we look up at other studies. For instance, a predominant location of the mental foramenin the region of the second lower bicuspid was found in previous studies[25,27,34-37]. In the current research, we observed such a location of the mental foramen in only 18% the sample we evaluated. Noteworthy of mention is that thosestudies were carried out in different ethnic groups. Further, in the current study, we evaluated a Brazilian sample using tomographic views and it is known that the Brazilian population is not physically homogeneous [36-37], which may explain the differences in the outcome in the current study as compared to other investigations.

Regarding mental foramen shape, the most common one found in the current study was oval with a frequency of 81.5% in the whole sample. This outcome is in line with one investigation carried out by Budhiraja and associates[35], reporting a frequency of oval shape in 74.3% of the sample. Furthermore, Udhaya and coworkers[27] and Voljevica and associates[18], reported frequencies of 83% and 83.3%, respectively. As a whole, these findings indicate that bone growth in different facial types do not significantly interfere in the mental foramen shape.

In the current investigation it was possible to observe symmetry regarding the measurements Apc-UBMF and LBMF-LBmand, as we did not find any statistically significant difference when comparing the left and right side in any of the facial types. On the other hand, the measurement Apc-UBMF in the mesocephalic group was significantly smalleras compared with those in thedolicocephalic and brachycephalic groups. The measurement LBMF-LBmandwasalso smaller inmesocephalic subjects when compared with dolicocephalic and brachycephalic ones. Further, the aforementioned measurement was smaller in dolicocephalic subjects than in brachycephalicones.Taken together, these data demonstrate that in general, facial types may influence both measurements: Apex of the second lower bicuspid-upper border of the mental foramen and lower border of the mental foramen-lower border of the mandible. This outcome is in line with one research[38] emphasizing the importance of being cautious during surgical planning as anatomic variations in the mental foramen position may be influenced by facial types.

The comparison of the three facial types demonstrated that mesocephalic subjects presented with smaller height of the mental foramen when compared withbrachycephalicsubjects. However, statistically significant differences were not observed when mesocephalic and brachycephalic subjects were compared with dolicephalic ones. Regarding width of the mental foramen, it was found that the mesocephalic type presented a smaller width when compared withbrachycephalic subjects, but only in the left side and significant differences were not observed when comparing only the right side. Regarding width of the mental foramen, there were no statistically significant differences comparing dolicocephalic subjects with other facial types. When the vestibular cortical was compared with the lingual one (Buccal cortical-Lingual cortical), this study demonstrated that mesocephalic subjects demonstrated a smaller thickness as compared withbrachycephalicanddolicocephalic individuals. However, significant differences were not found when brachycephalic and dolicocephalic subjects were compared.

Alterations in some measurements observed in mesocephalic individuals in the current study are in line with many similar studies[39-45]describingcharacteristics and differences among different facial types. Most of these studies reported that mesocephalic subjects presented normal musculature and harmonious facial characteristics free of muscular pressure. They also found that brachycephalic and dolicocephalic subjects demonstrated altered muscular and facial characteristicstogether with an abnormal facial shape. It is believed that growth and development of the lower jaw in amount and direction constitute the basis to understand the morphologic constitution of the face, for instance, when the mandible grows upward and forward, an increased facial depth, provides the individual with a brachycephalic trend, On the other hand, when the mandible grows downward and backward, there is a consistent increase in facial height, giving the individual a dolicocephalic trend. As a whole such information indicates that the quality of the craniofacial musculature, may significantly influence bone characteristics, and the surrounding anatomic structures, for instance, the mental foramen.

Albeit weak, there was a direct and significant correlation among all measurements when all facial types were considered as a group or set. Width and height of the mental foramen demonstrated a moderate correlation. Data segmentation in the different facial types strongly affected such correlation, indicating that segmentation significantly affected the relationships among diverse measurements. Regarding the brachycephalic group, there was no significant correlation when all measurements were compared, with the exception of height and width of the mental foramen. In the mesocephalic group, there was an inverse, significant but weak correlation between the measurements lower border of the mental foramen-lower border of the mandible and mental foramen height , indicating that when one measurement increases the other decreases. Regarding dolicephalic subjects, there was a direct correlation between the measurements mental foramen height with mental foramen width and mental foramen height with buccal cortical-lingual cortical of the mental foramen. This latter measurementwas also correlated with the measurement apex of the second lower bicuspid and upper border of the mental foramen. Additional correlations were observed between the lower border of the mental foramen-lower border of the mandible with the apex of the second lower bicuspid and the upper border of the mental foramen with mental foramen width. Taken together, data in the current study show that the relationship between one measurement and anothervaries greatly according to the patient´s facial type indicating the need for a comprehensive assessment of linear measurements using tomographic images. Such a need has been previously emphasized by Gomes and associates[38].

The outcome in the current study indicates that the facial type is a significant factor to be considered in clinical situations in which the morphologic location of the mental foramen is extremely important, for instance, during surgical planning and dental procedures in which local anesthesia is to be optimized. However, considering the importance of this subject and the scarcity of studies, additionalinvestigationsare needed tofurtherdemonstrate the influence of facial types in the location and morphology of the mental foramen.

## VI. Conclusions

Age and genre did not influence morphometric measurements; height of the mental foramen was slightly smaller in females than in males; facial types influence some cephalometric measurements; height of the mental foramen was smaller in mesocephalic subjects and width of the mental foramen was smaller in mesocephalic subjects but only in the left side of the mandible; mesocephalic subjects demonstrated a smaller distance between the buccal and lingual cortical of the mental foramen and most mental foramina were positioned between bicuspids. Oval was the most common shape of the mental foramen.

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**Table 1:** Age and genre in three different facial types

Facial Types

| AGE | Brachycephalic n=30 | | Dolycocephalic n=30 | | Mesocephalic n=30 | | p-value |
|---|---|---|---|---|---|---|---|
| Median | 17.1 | | 16.2 | | 15.9 | | 0.81* |
| Interquartile deviation | 3.1 | | 3.8 | | 4.5 | | |
| GENRE | n | % | n | % | n | % | |
| Females | 15 | 50 | 14 | 46.7 | 10 | 32.3 | |
| Males | 15 | 50 | 16 | 53.3 | 20 | 67.7 | |
| TOTALS | 30 | 100 | 30 | 100 | 30 | 100 | |

*Kruskal-Wallis´ statistics

Table 2: Pearson´s correlation rho: Measurements and Age

| Variable versus Age | Pearson´s rho | p-value |
|---|---|---|
| Apex of the second bicuspid-Upper border of the mental foramen | -0.03 | 0.67 |
| Lower border of the mental foramen-lower border of the mandible | 0.05 | 0.49 |
| Mental foramen height | -0.04 | 0.61 |
| Mental foramen width | -0.06 | 0.44 |
| Buccal cortical-Lingual cortical of the mental foramen | 0.01 | 0.87 |

**Table 3:** Influence of Genre on specific variables (Mean + Standard Error in mms.)

| Variables | Females=78 | Males=106 | p-value |
|---|---|---|---|
| Apex of second bicuspid-upper border of mental foramen | 4.3 +- 0.16 | 4.15 +- 0.11 | 0.46 |
| Lower border of mental foramen-lower border of the mandible | 7.13 +-0.2 | 7.14 +-0.17 | 0.46 |
| Mental foramen height | 3.91 +-0.07 | 4.3 +- 0.08 | 0.0003* |
| Mental foramen width | 4.24 +-0.07 | 4.44 +-0.07 | 0.05 |
| Buccal-Lingual cortical of the mental foramen | 6.23 +-0.11 | 6.19 +-0.09 | 0.77 |

*With Welch´s correction

**Table 4:** Relative distribution of mental foramen position using the lower second bicuspid as a reference

Subgroups
Brachycephalic DolicocephalicMesocephalic Totals
n=30 n=30 n=30 90

| POSITION | Right | | Left | | Right | | Left | | Right | | Left | | n | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % | n | % | n | % | | |
| Between bicuspids | 19 | 61.3 | 20 | 64.5 | 20 | 66.7 | 24 | 80 | 25 | 80.6 | 27 | 87.1 | 135 | 73.4 |
| Long axis of second lower bicuspid | 9 | 29 | 9 | 29 | 6 | 20 | 3 | 10 | 6 | 19.4 | 4 | 12.9 | 37 | 20.1 |
| Distal to second lower bicuspid | 2 | 6.5 | 1 | 3.2 | 3 | 10 | 1 | 3.3 | | | | | 7 | 3.8 |
| Distal to first lower bicuspid | 1 | 3.2 | 1 | 3.2 | | | | | | | | | 2 | 1.1 |
| Between second bicuspid and first molar | | | | | 1 | 3.3 | 1 | 3.3 | | | | | 2 | 1.1 |
| Mesial to first lower bicuspid | | | | | | | 1 | 3.3 | | | | | 1 | 0.5 |

**Table 5:** Pearson correlations between diverse measurements as a function of facial types.

Pearson/p-value Pearson/p-value Apc-UbmfLbmf-LbmandMfhMfw

| | | | | | |
|---|---|---|---|---|---|
| All Facial Types | LBMF-LBmand | 0.37 0.0001 | | | |
| | MFH | | | | |
| | MFW | 0.32 0.0001 | 0.24 0.001 | | |
| | BCMF-LCMF | 0.22 0.003 | 0.26 0.0004 | 0.54 0.0001 | |
| | | 0.4 0.0001 | 0.18 0.01 | 0.16 0.03 | 0.17 0.01 |
| Brachycephalics | | | | | |
| | LBMF-LBmand | -0.21 0.09 | | | |
| | MFH | | | | |
| | MFW | 0.17 0.18 | -0.07 0.58 | | |
| | BCMF-LCMF | 0.14 0.26 | 0.08 0.55 | 0.63 0.0001 | |
| | | 0-16 0.20 | -0.02 0.85 | -0.22 0.08 | 0.03 0.8 |
| Dolicocephalics | | | | | |
| | LBMF-LBmand | 0.3 0.02 | | | |
| | MFH | | | | |
| | MFW | 0.24 0.06 | 0.22 0.09 | | |
| | BCMF-LCMF | 0.14 0.27 | 0.26 0.04 | 0.43 0.0006 | |
| | | 0.45 0.0003 | -0.08 0.55 | 0.38 0.002 | 0.24 0.06 |
| Mesocephalics | | | | | |
| | LBMF-LBmand | -0.12 0.33 | | | |
| | MFH | | | | |
| | MFW | -0.06 0.04 | -0.3 0.01 | | |
| | BCMF-LCMF | -0.09 0.47 | 0.01 0.9 | 0.23 0.06 | |
| | | -0.15 0.24 | 0.14 0.28 | -0.02 0.9 | 0.06 0.6 |

**Table 6:** Percentages of shapes of the mental foramen and facial types

| Facial Type: | OVAL | CIRCULAR |
|---|---|---|
| | % | % |
| Mesocephalic | 80.6 | 19.0 |
| Brachycephalic | 77.4 | 22.0 |
| Dolycocephalic | 86.0 | 13.0 |
| | | |