Anteroposterior location of the mandibular foramen of 7 to 12 year-old children in panoramic radiographs

Localização ântero-posterior do forame mandibular em crianças na faixa etária de 7-12 anos por meio de radiografias panorâmicas

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Abstract

The mandibular foramen (MF) location is considerably important in dentistry practice. It determines the success of anesthesia procedures on the mandibular structures. Many researches about its location in adults can be found in the literature; however the results are not always in agreement. The aim of this study was to evaluate the anteroposterior position of the MF, and verify the possible changes on its location on 7 to 12 year-old children. Ninety panoramic radiographs from the Dentomaxillofacial Radiology department at the Dentistry School of São José dos Campos – São Paulo State University – were examined. The shortest anteroposterior length of the mandibular ramus and the distance between the point correspondent to the MF to the deepest portion of the anterior border of the mandibular ramus were obtained using a digital caliper. All the measurements were registered in millimeters. The ratio between the measurements was calculated. The descriptive statistic analysis and the 95% confidence interval ANOVA (one-way) test were applied. The results showed that the anteroposterior location of the MF is, on average, at the medium third of the mandibular ramus. No statistically significant differences were found between ages ($p>0.05$).

Uniterms

Radiography, panoramic; mandible; analysis of variance; child.

INTRODUCTION

The assessment of the mandibular foramen (MF) is of a considerable importance for surgery planning, endodontic treatments and lesions diagnosis. Incorrect estimations of its location might be the explanation to the unsuccessful anesthesia of the inferior alveolar nerve.

A radiolucent line delimited by two outer radiopaque lines radiographically represents the mandibular canal (MC). Its path begins at the MF, extending until the mental foramen. However, anatomic and patologic variations may determine different radiographic images.

A deep and efficient anesthesia is essential to Dentistry. Although it is a simple procedure in the maxilla, anesthesia in the mandible may be associated with some difficulty. The success of this technique depends on the proximity between the anesthesic needle and the mandibular foramen (MF), which location is variable (Nicholson[16], 1985).

Despite of its limitations, the panoramic radiograph is the most preferred radiographic technique to localize the mandibular canal.

According to Alattar[2] (1980) and Langlais et al.[13] (1985), panoramic radiographs are simple to be acquired and require a minimum amount of time for its execution. Furthermore, both maxilla and mandible are projected at the same view with a relatively low radiation dose. Another advantage of this type of projection is the minimum cost when compared to CT scans. However, its final image is often magnified, with definition loss and anatomic structures superimposition. The diagnostic value of those images is less sensitive in comparison to CT and intraoral images (Frykolm[6], 1977).

Lindh & Peterson[14] (1989) compared panoramic and conventional tomographic images as tools to visualize the mandibular canal. These authors stated that the tomography gave a significantly clearer image of the canal at and 1cm posterior to the mental foramen, while no differences were found between the methods 2cm posterior to the mental foramen.

Amir et al.[3] (1998) measured 25 dried human skulls from both male and female sexes, with ages ranging between 27 and 78 years. Metallic reference marks were established on the mandibles so that measurements could be done on the panoramic projections. These authors concluded that different measurement parameters can be employed both horizontally and vertically on panoramic images, as long as they are applied at only one of the sides of the jaws without over passing the midline.

In conformity to Nortjé et al. [17] (1977), the mandibular canals are in general, but not invariably, bilaterally symmetrical, with only a single principal canal. Supplementary canals large enough to be seen on radiographs are occasionally present. In this case, the most common configuration is the double canal originated from a single foramen. On the other hand, the less common type is the one originated from two distinct foraminas.

In 1985, Langlais[13] et al concluded that bifid mandibular canals are not uncommon to be found.

Devito & Tamburús[5] (2001) found 7.85% of the studied cases with some type of bifurcation of the MC. In relation to its location, 41.83% of the MCs were bilateral high, while 32.09% were bilateral intermediate and 3.44% were bilateral low. 22.64% of the cases showed other variations. According to those authors, the panoramic radiograph is a useful tool to determine the anatomy and variations of the MC.

In 1977, Hayward et al.[8] assessed 107 dried skulls, 45 of which were Asian and the other 62 belonged to white and black individuals. Their aim was to determine the anteroposterior position of the MF. Measurements of the length between the anterior border of the ramus and the anterior aspect of the MF and between the MF and the posterior border of the ramus were obtained. The results demonstrated that the anteroposterior location of the MF is at the third quadrant. Statistically non-significant differences were noted between the studied samples and between the right and left ramus.

Nicholson[16] (1985) examined eight dried adult human mandibles with erupted third molars. Their aim was to verify the location of the MF. They concluded that the MF was vertically and horizontally located at the center of the mandibular ramus. At the majority of the cases, the MF was found below the oclusal face of the molars.

Hetson et al.[10] (1988), in their studies with 317 hemi-mandibles, concluded that the MF is placed immediately posterior to the center of the ramus.

After examining 79 adult mandibles with all the permanent teeth in place, Mwanini & Hassanali[16] (1992) found that the anteroposterior and vertical location of the MF match with the ones found respectively by Nicholson[16] (1985) and Hayward et al.[8] (1977). Also, 64.6% of the studied pieces had the MF placed below the occlusal plane and 30.7% showed the MF located at the level of the occlusal plane.

Kaffe et al.[11] (1994) evaluated, measured and radiographed 100 human mandibles. They found a statistically significant correlation between the location of the MF on radiographs and the narrowest anteroposterior length of the mandibular ramus.

Afsar et al.[1] (1998) assessed the localization of the MF on 79 panoramic images using the same anatomic bony structures presented by Nicholson[16] (1985). Oblique cefalometric radiographs at 45º, which gave true images of one side of the mandible body, were taken according to a previous research. The mean ratios between the two types of images showed insignificant differences. No sex and age correlation could be found. On panoramic radiographs, the mean position of the MF was 1.9 ± 4mm superior to the occlusal plane. However, the authors stated that the position of the MF cannot be found at a specific aspect of the mandibular ramus or determined by any proportion related to the anatomic bony structures employed.

Only studies using adult samples were found on the reviewed literature. Therefore it is evident the need for knowledge about the position of the MF on pediatric patients. An accurate knowledge of the position of this structure will bring, among other benefits, a more effective anesthesic blockage, which in turn brings an easier patient conditioning. Hence, the aim of the present study is to assess the position of the mandibular foramen (MF) by means of linear measures on panoramic radiographs in 7 to 12 year-old patients compared to samples of different ages, observing the possible changes on the location of this structure.

Material and Method

The sample was composed by ninety panoramic radiographs from both male and female individuals (15 images for each age group), with ages ranging between seven and 12 years. The radiographs belong to the Oral and Maxillofacial Radiology Department archives at the Dentistry School of São José dos Campos – State University of São Paulo (UNESP). The images had to present good quality at the sites of the structures to be evaluated.

The radiographs were assessed by a previously trained observer in a darkened room with a light-box with variable light intensity and a mask to limit the light to the radiograph area.

The limits of the mandibular ramus and the mandibular foramen were drawn on 60g, 10cm x 7 cm cellophane paper, attached to the radiograph with pieces of tape, using a 0.5mm pencil. The drawing was based on the limit of the most external radiopaque portion of the mandibular canal and mandibular foramen (Figure 1).

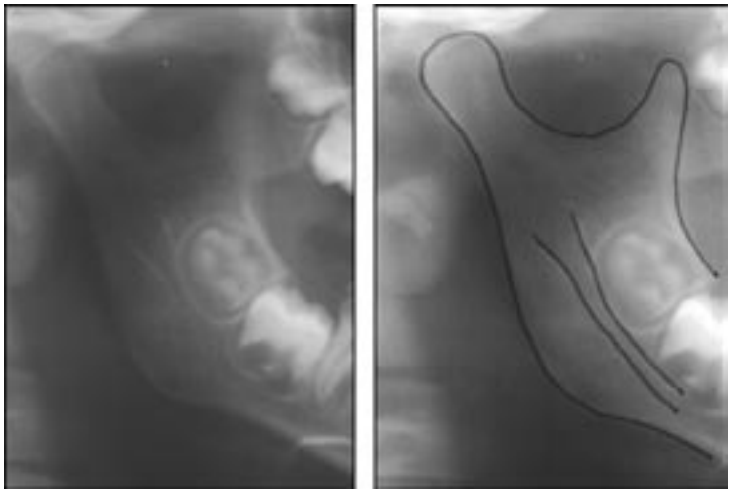


FIGURE 1 – Drawing the mandibular ramus, part of the mandibular canal and mandibular foramen.

In order to standardize the measures, reference marks were determined (Figure 2):

- s point: the deepest portion of the anterior border of the mandibular ramus;
- z point: the deepest portion of the posterior border of the mandibular ramus;
- f point: mandibular foramen (at the center of the radiolucent area);
- f' point: projection of the f point on the s-z line.

The "s" and "z" points were established after the lines tangent to the anterior and posterior border of the ramus were traced.

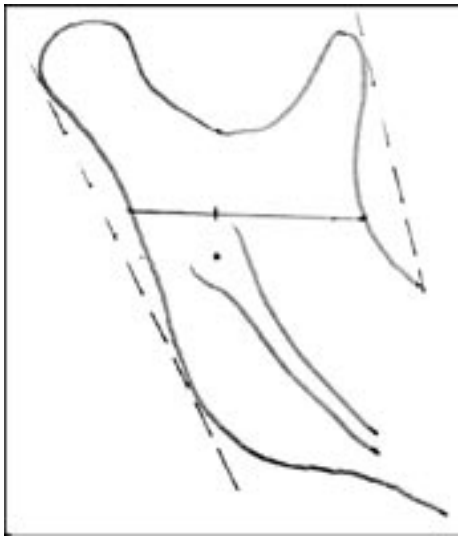


FIGURE 2 – Anatomic references and measures calculated on the panoramic radiograph

Two measures were then obtained on the right side of the mandible, in millimeters (mm), using a digital caliper:

- the shortest anteroposterior distance of the mandibular ramus (s-z line);
- f'-s distance.

Mean descriptive statistical analysis and standard deviation for the proportion between the shortest anteroposterior distance of the mandibular ramus and the distance between the MF to the anterior border of the ramus were done to all the age groups. The one-way ANOVA test was applied to compare the mean ratios among the age groups. The percentile of occurrence of the MF location was also determined.

RESULTS

The results obtained from the descriptive statistical analysis of the proportion between the shortest anteroposterior distance of the mandibular ramus and the f'-s distance in all the age groups are shown on Figure 3.

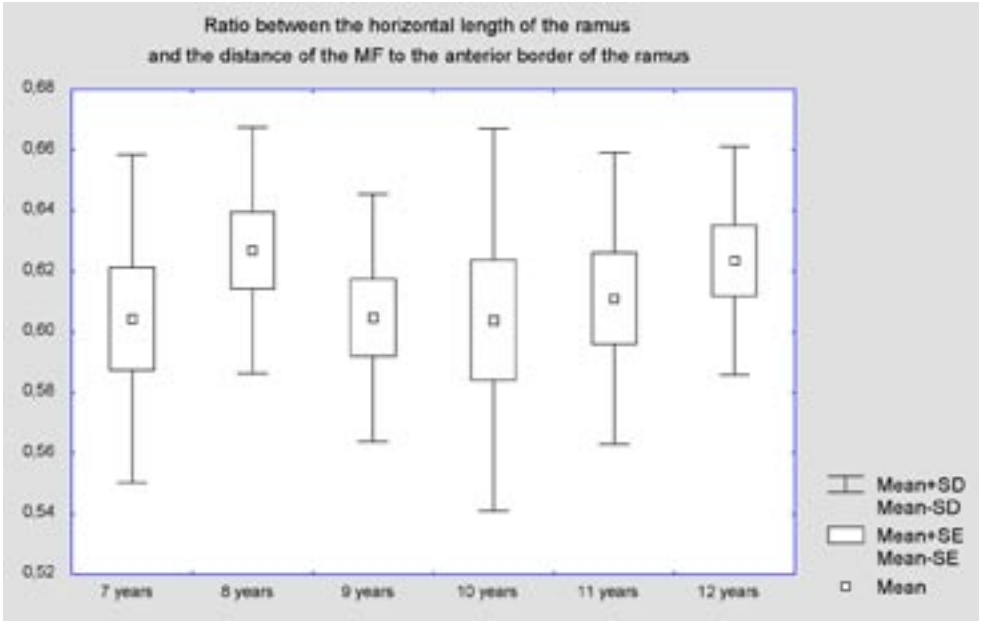


FIGURE 3 – Mean, standard deviation and standard error of the proportion between the horizontal length of the ramus and the distance between the MF to the posterior border of the ramus.

The data shows where the MF is most frequently found in each age group. Table I displays this prevalence in percentiles.

Table 1 – Percentile data of the MF location on the three thirds of the ramus in each group age

Age	Anterior third	Middle third	Posterior third
7 years	-	73.33%	26.67%
8 years	-	86.66%	13.34%
9 years	-	66,66%	33,34%
10 years	-	73.33%	26.67%
11 years	-	80%	20%
12 years	-	93.33%	6.67%

One-way ANOVA test with 95% confidence, showed statistically non-significant differences on the measures among the age groups *(p=0.858)*.

Discussion

The knowledge of the position of the mandibular foramen is of a great importance for many procedures in dentistry. Its precise location enables a more effective anesthesia, which in turn leads to an easier patient conditioning (Bremer[4], 1952; Groover & Lorton[7], 1983; Heasman[9], 1987)

The panoramic radiographs have been widely used as a tool to the observation of both the mandibular canal anatomy and the mandibular foramen position (Prado[18], 1999). It also gives the clinician the possibili-

ty of assessing the entire maxillo-mandibular complex with a relatively low radiation dose (Alattar[2], 1980; Langlais et al.[13], 1985; Klinge et al.[12], 1989).

Frykolm[6] (1977), Tronje[20] (1982) and Stramotas et al.[19] (2002) mentioned some disadvantages of the panoramic radiograph, such as image magnification, loss of definition and less accurate diagnostic value when compared to the tomographic images. On the other hand, Lindh & Peterson[14] (1989) couldn't find differences between the panoramic and tomographic images on the visualization of the mandibular canal 2cm posterior to the mental foramen.

Amir et al.[3] (1998) stated that the measurements to locate the anatomic structures could be done on panoramic radiographs only if one of the sides is used without over passing the sagittal midline. According to these authors, the mean ratios between the MF position on panoramic and profile cephalometric radiographs are non-significant.

In our study, the right side of the mandible was chosen at random as the side where the measures were obtained. The reason for a random determination is the variable magnification rates on different sites of the mandible on panoramic images.

The mean ratios and the standard deviations between the shortest anteroposterior length of the mandibular ramus and the f'-s length demonstrates that most frequent horizontal location of the MF is on the posterior portion of the middle third of the mandibular ramus. This result is in agreement with the conclusions of Hayward[8] et al. (1977) and Mwaniki & Hassanali[15] (1982). According to Nicholson[16] (1985), the MF is predominantly located at the center of the mandibular ramus. Heston[11] et al stated that the MF is located immediately posterior to the center of the ramus.

No statistically significant differences on the MF location among the group ages were found in this study ($p>0.05$). However, we highlight the importance of longitudinal studies to verify if the position of the MF changes during the development of the mandible.

Conclusion

Based on the obtained results, we conclude that the mandibular foramen is frequently located on the mid-third of the mandibular ramus, keeping a constant proportion to the shortest anteroposterior length of the ramus in all the age groups.

RESUMO

A localização do forame mandibular (FM) é bastante importante na prática odontológica, pois disso depende o sucesso da anestesia de estruturas encontradas na mandíbula. Os estudos sobre sua localização são muitos, entretanto, realizados, na totalidade da bibliografia consultada, em adultos, e os resultados são variados. Os objetivos neste estudo foram avaliar a posição do FM, no sentido ântero-posterior, e possíveis mudanças dessa posição, ocorridas em crianças com idades entre 7 e 12 anos. Foram examinadas 90 radiografias panorâmicas pertencentes ao arquivo da Disciplina de Radiologia Odontológica da Faculdade de Odontologia de São José dos Campos – UNESP. Utilizando-se de um paquímetro digital, medidas da menor distância antero-posterior do ramo e a distância do ponto correspondente ao fm ao ponto mais profundo do bordo anterior do ramo foram obtidas em milímetros. Realizou-se a proporção das duas medidas. Aplicaram-se análise estatística descritiva e teste anova (one-way). A análise dos resultados permitiu concluir que houve maior prevalência do FM no terço médio posterior do ramo, ântero-posteriormente. Não houve diferenças significativas da localização do FM entre as idades avaliadas (p>0,05).

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Radiografia panorâmica; mandíbula; análise de variância; criança.

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