Radiographic Study of the Location of Mental Foramen in a Randomly Selected Asian Indian Population on Digital Panoramic Radiographs


The present study was undertaken to determine the most common position of mental foramen in a randomly selected Asian Indian population using digital panoramic radiographs. 500 digital panoramic radiographs were evaluated using the software-Sidexis (Sirona, Germany). The location and symmetry of mental foramen in the subjects were determined. All the data was analyzed using chi square test. It was found that the most common position for the mental foramen relative to the teeth in sample was between the first and second premolars (n = 476, 47.6%). The second most common location was in line with second premolar (n = 335, 35.5%). The mental foramen was symmetrical in 285 (57%) radiographs, with the remaining 215 (43%) being asymmetrical. The accurate identification of the mental foramen is important for diagnostic procedures like diagnosis of periapical lesions in mandibular premolar region and for clinical procedures like orthognathic surgery, periapical surgery, osteotomy, dental implant placement. Trauma to the mental nerve is preventable if the mental foramen is located and this knowledge is employed when performing surgical procedures in this area.

Key words: Mental foramen, anatomic landmark, premolar, panoramic radiograph, Asian Indian population, symmetry

1Department of Pedodontics and Preventive Dentistry, Pushpagiri College of Dental Sciences, Thiruvalla, Kerala, India
2Department of Pedodontics and Preventive Dentistry, Padm Dr. D Y Patil Dental College and Hospital, Nerul, Navi Mumbai, India
3Pushpagiri College of Dental Sciences, Thiruvalla, Kerala, India
4Maxillofacial Diagnostics, Kaloor, Kochi, Kerala, India
5Department of Pedodontics and Preventive Dentistry, Rajah Muthiah Dental College and Hospital, Annalalai University, India
INTRODUCTION

The mental foramen is defined as the entire funnel like opening on the lateral surface of the mandible at the terminus of the mental canal (Phillips et al., 1992a). The mental foramen marks the termination of the mandibular canal in the mandible and transmits the mental vessels and nerve which provide the blood supply and sensory innervation to the lower lip, buccal vestibule, gingiva mesial to the mandibular first molar and the anterior aspects of the chin on the ipsilateral side of the mandible (Bavitz et al., 1993).

According to Phillips et al. (1990) the accurate identification of the mental foramen is important for both diagnostic and clinical procedures. The radiographic appearance of the mental foramen may result in a misdiagnosis of a radiolucent lesion in the apical area of mandibular premolar teeth. Hwang et al. (2005) stated that clinically, the mental bundle could be injured during orthognathic surgery (especially sliding genioplasty) and periapical surgery. It is a strategic landmark during osteotomy procedures (Greenstein and Tarnow, 2006). It is also of vital importance to the practice of acupuncture as the Jiachenjiang point lies within the mental foramen (Oliveira et al., 2009). Moiseiwitsch (1998) noted that regional anesthesia of the terminal incisive branches of the inferior alveolar and mental nerves can be obtained effectively if the mental foramen is correctly identified. One of the treatment options of the last decade for restoring edentulism is osseous dental implants (Kapas et al., 2007). Benson and Brooks (2001) stated that the recent trend of using dental implants have greatly increased the interest in mental foramen localization as the mental nerve can be damaged during implant surgery. This can be avoided if the distal surface of the most posterior implant is one millimeter anterior to the anterior border of the mental foramen (Bavitz et al., 1993). According to Greenstein and Tarnow (2006) mental nerve injury can cause transitory or permanent sensitive, thermal and tactile changes. These altered sensations are preventable if the mental foramen is located and this knowledge is employed when performing surgical procedures in the foramen area.

Generally, the mental foramen is difficult to locate due to lack of consistent anatomic landmarks for reference and the foramen cannot be clinically visualized or palpated (Phillips et al., 1990). As a result, variable anatomic positions of the foramen have been described. Most studies and textbooks describe the location of the mental foramen as below and between the apices of the first and second premolar (Olasoji et al., 2004; Gungor et al., 2006; Al-Khateeb et al., 2007; Hajghafer and Rokouei, 2009) or as being below the apex of the second premolar (Phillips et al., 1992b, Shankland, 1994; Al-Jasser and Nwoku, 1998; Ngeow and Yuzawati, 2003; Al-Talabani et al., 2008; Amorim et al., 2008). Malamed (2004) reported that both locations are common. However, According to Moiseiwitsch (1998), individual variation could place the mental foramen anywhere from below the canine to between the roots of the first molar.

Panoramic radiography is a curved plane tomographic technique used to depict the body of the mandible, maxilla and the lower half of the maxillary sinuses on a single image. Akhoondali et al. (2009) have proposed a fully automatic technique for extraction of panoramic dental images from CT scan images of teeth. Despite the development of advanced radiological exams such as computed tomography, the conventional radiographs are more commonly used, since advanced imaging techniques exposes the patient to higher doses of radiation (Ahmed et al., 2007). Jalili (2010) investigated the position of mandibular foramen using panoramic radiography. It has been used in locating the mandibular foramen relative to occlusal plane (Mohamad et al., 2011). Panoramic radiography has gained popularity in the last four decades and is probably the most utilized diagnostic modality in dentistry for localization of the mental foramen. Based on its radiographic appearance, the mental foramen has been classified by Yusue and Brooks (1989) into four types:

Type I: Mental canal is continuous with the mandibular canal
Type II: Foramen is distinctly separated from the mandibular canal
Type III: Diffuse with a distinct border of the foramen
Type IV: Unidentified type, in which the mental foramen cannot be identified on panoramic radiographs under ordinary exposure and viewing conditions

The present study was undertaken to determine the most common position of the mental foramen in a randomly selected Asian Indian population using digital panoramic radiographs.

MATERIALS AND METHODS

723 digital panoramic radiographs of randomly selected Asian Indian subjects who were referred to Maxillofacial Diagnostics, (Kochi, Kerala, India) over a period of one year prior to September 2010 were retrospectively analyzed. All the digital panoramic radiographs were taken using Orthophos XG 5 DS/Ceph (tube potential: 60-90 KV, tube current: 3-16 mA, total filtration: >2.5 mm Al, effective focal spot: 0.5 mm and exposure time: 141 seconds). The magnification factor for the region from posterior border of ramus to canine, as
reported by the manufacturer was 1.25. 500 radiographs (250 males and 250 females) were selected after those with the following criteria were excluded:

- Patient under 18 years of age
- Presence of radiolucent/radiopaque lesions in the lower jaw
- Presence of missing teeth in lower jaw other than third molars
- Non visualization of mental foramen bilaterally
- Incomplete eruption of permanent teeth other than third molars in lower jaw
- Presence of supernumerary teeth in lower jaw
- Presence of periodontal lesions in lower jaw
- Patient with previous/current orthodontic treatment
- Presence of crowding/spacing of teeth in lower arch

The position of the image of the mental foramen on either side was recorded according to Haghaniifar and Rokouei (2009).

Vertical lines were drawn along the long axis of the mandibular premolar teeth on the digital panoramic radiographs using the software-Sidexis (Sirona, Germany), to indicate the mental foramen in any of the above positions. The same operator analyzed all the digital panoramic radiographs.

**Statistical analysis:** The subject’s age, sex and the position of the foramen on each side (to assess symmetry) were recorded in the recording form. The percentages were calculated and the data was analyzed using chi square test.

### RESULTS

The appearance and location of mental foramen were determined on digital panoramic radiographs of 500 subjects (250 males, 250 females). The mean age of the subjects was 31.67. The youngest patient was 18 years old and the oldest patient was 79 years old.

The most common position for the mental foramen relative to the teeth in sample was position 3 (between the first and second premolars) (n = 476, 47.6%). The second most common location was position 4 (in line with second premolar) (n = 353, 33.5%), followed by position 5 (n = 114, 11.4%), position 1 (n = 35, 3.5%), position 6 (n = 30, 3%) and position 2 (n = 10, 1%) (Table 1).

In male subjects, the most common position for the mental foramen relative to the teeth was position 3 (n = 230, 46%). The second most common location was position 4 (n = 160, 32%), followed by position 5 (n = 70, 14%), position 1 (n = 20, 4%), position 6 (n = 15, 3%) and position 2 (n = 5, 1%). In female subjects, the most common position for the mental foramen relative to the teeth was position 3 (n = 246, 49.2%) (Table 2). The second most common location was position 4 (n = 175, 35%), followed by position 5 (n = 44, 8.8%), positions 1, 6 (n = 15 each, 3%) and position 2 (n = 5, 1%) (Table 2).

The mental foramen was symmetrical in 285 (57%) radiographs, with the remaining 215 (43%) being asymmetrical. For the symmetrically placed mental foramen, the most common position was position 3 (n = 150, 52.5%) followed by position 4 (n = 95, 33.3%), position 5 (n = 30, 10.5%) and position 1, 6 (n = 5 each, 1.75%). No case with symmetrically placed mental foramen was noted in position 2. Statistically significant differences were not seen between males and females based on symmetry and asymmetry of the location of mental foramen on both sides. p<0.05 was taken to indicate statistical significance (Table 3).
DISCUSSION

Radiography is the most commonly used non-invasive method for diagnosis and treatment planning of major surgical procedures of the mandible. Panoramic radiographs are commonly used for screening, diagnosis and selecting the best possible surgical approach (Gungor et al., 2006). In the present study, panoramic radiographs were utilized because they have certain advantages over intraoral radiographs. They include a greater area of hard and soft tissue and also the ability to visualize adjacent areas, thus allowing for a more accurate localization of the mental foramen in both horizontal and vertical dimensions. Periapical radiographs do not reveal the position of the mental foramen if it falls below the edge of the film (Phillips et al., 1992a). In the present study, since digital panoramic radiographs from the same machine were utilized, errors and variations related to contrast, film processing etc was minimized. The novel use of the software Sidexis (Sirona, Germany) in this study, further minimized possibility of error in determining the location of the mental foramen. According to Kjaer (1989), the location of mental foramen could change during development of the jaws, digital panoramic radiographs of subjects over 18 years were chosen for this study. Presence of radiolucent/radiopaque lesions in the lower jaw, missing teeth/ incomplete eruption (other than third molars), supernumerary teeth, periodontal lesions and previous/current orthodontic treatment in the subjects were excluded as these conditions could cause tooth migration leading to erroneous interpretation of the location of the foramen in relation to the teeth.

In the analysis of 500 digital panoramic radiographs, it was found that the mental foramen was positioned anywhere between the long axis of the canine to that of the mesiobuccal root of the first molar which agrees with the findings of other researchers (Shankland, 1994, Al-Jasser and Nwoku, 1998, Moiseiwitsch, 1998).

However, the most common position was in between the first and second premolars, followed by in line with the second premolar. This is in agreement with the results of studies done by Moiseiwitsch (1998) in a North American white population Olasoji et al. (2004) in Northern Nigerian adults, Gungor et al. (2006) in a Turkish population, Haghanifar and Rokouei (2009) in an Iranian population. However, studies done in other populations such as Kenyan African by Mwaniki and Hassanali (1992), Asian Indian by Shankland (1994), Saudi population by Al-Jasser and Nwoku (1998), Malay by Ngeow and Yuzawati (2003), Kurdish population by Al-Talabani et al. (2008) and in Brazilian population by Amorim et al. (2008) have indicated that the mental foramen is most commonly positioned in line with the second premolar tooth.

In the present study, mental foramen was symmetrical in 57% of the radiographs and this was much lower than the percentages of symmetrically positioned foramen observed in other populations -Malays 67.7% (Ngeow and Yuzawati, 2003), Turkish 90.4% (Gungor et al., 2006), North Jordanian 77% (Al-Khateeb et al., 2007), Kurdish 82.7% (Al-Talabani et al., 2008), Iranian 85.7%, (Haghanifar and Rokouei, 2009). Ngeow and Yuzawati (2003) stated that this location of the mental foramen in relation to the lower first and second premolars is influenced by genes and that other positions could be due to a lag in prenatal development. The reason for the difference in position could also be due to the shape of the foramen itself. The direction of exit of mental foramen through the buccal cortical bone of the mandible is usually in a posterior and superior direction. The smallest diameter of the foramen would usually be inferior and mesial to the buccal surface of the mandible and the radiographic mental foramen would thus correspond to the smallest diameter of the foramen on the internal surface of the buccal plate. This is also the area where the mental nerve joins the cortical bone (Phillips et al., 1992b). However, it should be noted that since inter-patient variation with respect to position in the focal plane will always be present, distortion and magnification factors inherent in the orthopantomogram techniques cannot be eliminated (Ramstad et al., 1978). Again, the radiation beam of the panoramic machine comes from the lingual side of the mandible with a resultant increase in the separation between the apices of teeth and the mental foramen (Phillips et al., 1992a). Hence this technique would be unsuitable for studies requiring quantitative measurements without the incorporation of a correction factor for each patient.

The present study was limited to evaluation of the position of the mental foramen relative to the mandibular teeth using digital panoramic radiographs of a small sample of Asian Indian subjects. Clearly, further studies utilizing a larger sample size and evaluating the mental foramen in both horizontal and vertical planes using quantitative measurements and advanced imaging modalities would be required for a more precise identification of the mental foramen.

CONCLUSION

The following conclusions were drawn from the results of the present study:
• The most common locations of the mental foramen in the Asian Indian population are between the two premolars followed by in line with the second premolar.
• The mental foramina are symmetrically located in majority of the Asian Indian population but the percentage of symmetry is lower as compared to other populations studied across the world.
• Gender and symmetry/asymmetry did not influence the position of mental foramen in this population.

ACKNOWLEDGMENT

Ms Nisha Kurien (Assistant Professor of Biostatistics, Department of Community Medicine, Pushpagiri Medical College, Tiruvalla, Kerala, India), is thanked for the assistance rendered in the statistical analysis.

REFERENCES
