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Characteristics of anatomical landmarks in the maxillary palatal region: A cone beamed computed tomography study

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ABSTRACT

Introduction: Many minor surgical procedures require injection of local anesthetic solution to avoid patient discomfort. Most of the time, multiple injections are required to anesthetize the anterior maxilla in the region of the premolars to incisors. Hence, the purpose of this study is to assess appearance, visibility, location, and course of the anatomical landmark of palatal canal for AMSA through limited cone beam computed tomography (CBCT).

Materials and Methods: 100 subjects were investigated on CBCT images for precise anatomy of the palatal canal bilaterally. The data collected for assessing the relative position of the canals included the following: a) position of the foramen, b) measurement from the tooth apex, c) diameter of the canal d), nature/shape of the canal e), and level of foramen from the tooth apex.

Results: The presence of foramen was observed in 44% of the images, respectively. The foramen was predominant in premolar region (64.9%), distance of 13.77mm, and canal width of 1.20mm, either clear or bifid canal, and the level being at upper or at lower or at the apex of tooth.

Conclusion: The palatal canal is an important landmark for the AMSA, an alternative technique to the infraorbital nerve block to avoid the facial soft tissue anesthesia. More studies are required to assess the exact anatomy, course, nature, and shape of the palatal canal and other nutrient canals in the region of anterior and middle superior nerves.

Key words: *Anesthesia, CBCT, maxilla, nerve, palatal*

Introduction

The variations in the neural branching pattern and topographic relations in the maxilla and mandible often cause failure in obtaining the adequate local anesthesia in dental procedures. Anatomical variations of mandibular nerve have been described by various authors in the literature but little data is available concerning neural anatomic variations in the maxilla, which is of prime importance to the maxillofacial surgeons. This is due to its complicated anatomy, regional variations, and complex association with the neighboring structures [1-3].

Maxillary minor surgical procedures often require multiple injections to obtain anesthesia of the hard and soft tissues. The series of injections which effectively anesthetize maxillary anterior teeth and tissues includes infraorbital nerve block for buccal tissues and nasopalatine nerve block for the palatal tissues. For premolar region additionally greater palatine nerve

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block has to be given. But the infraorbital anesthesia unintentionally affects the facial structures like upper lip, lateral aspect of the nose, and lower eyelid. To reduce the multiple injections and to avoid the sequelae of other symptoms many authors have exerted an effort to establish a new anesthetic technique to deal with the maxillary dentoalveolar procedures [4].

The anterior and middle superior alveolar (AMSA) nerves branch from the infraorbital nerve before they exit from the infraorbital foramen. The anterior superior alveolar nerve provides pulpal innervation to the central and lateral incisors and canines. The middle superior alveolar nerve is thought to innervate the maxillary premolars and plays some role in pulpal innervation of the mesiobuccal root of the first molar. The plexus where both nerves join is the target site for the AMSA injection [5].

The anterior middle superior alveolar nerve block (AMSA) technique, which anesthetizes the anterior superior alveolar nerve, the middle superior alveolar nerve, and the subneural dental nerve plexus, was described by Friedman and Hochman in 1998. This palatal anesthesia is achieved without numbness to the lips and face or interference with the muscles of facial expression. Bilateral AMSA injection is supposedly anesthetized from the second premolar on one side to the second premolar on the opposite side [6].

Perry and Loomer located the site of AMSA injection on the hard palate at the intersection of a vertical line bisecting the premolars and a horizontal line halfway between the mid-palatine raphe and the crest of the free gingival margin [7]. AMSA injection has been recommended for procedures like operative restorations, scaling, and root planning, and esthetic and cosmetic procedures to evaluate the smile line.

Hence, we present a retrospective study using cone beamed computed tomography (CBCT), which is a unique study showing the ubiquitous nature of the palatal canal mingling in various pattern to anterior and middle superior neural dental plexus.

Materials and Methods

The study included 100 CBCT scans from patients with either edentulous or dentulous maxillary jaw. The scans had been taken with informed consent, as part of diagnostic procedures from the patients undergoing maxillary implants with age range of 19–44 years. Detailed clinical history of the subjects was also recorded.

Patients were investigated on CBCT images for the precise assessment of the palatal canal bilaterally. The study was approved by the Institutional Ethical Board. The positional relationship between palatal canal and the tooth was investigated as well. The relative positions of the palatal canals were assessed based on the following: a) position of the foramen, b) measurement from the tooth cementoenamel junction (CEJ), c) diameter of the canal, d) nature/shape of the canal, and e) level of foramen from the tooth apex.

All the values recorded through CBCT were tabulated and statistical analysis was performed using Chi Square Test.

Results

100 subjects were scanned for CBCT assessment including 55 females and 45 males. The age range of the subjects was 19–44 years, with a mean age of 30.18 years.

The assessment of position of the palatal foramen through CBCT showed 64.9% in premolar region and 35.1% in canine region. The distance of the palatal foramen was measured from the CEJ of the nearest tooth (either premolar or canine) which showed a mean of 13.77 mm (Figure 1). The mean diameter of the canal was 1.20 mm. The CBCT showed presence of bifid palatal canal near the dental plexus in 44% of subjects. The clear palatal canal till the dental plexus was observed in 56% of subjects. The level of foramen appeared more at upper level from the tooth apex (38.2%) followed by lower level from the tooth apex (29.2%) and at the level of tooth apex (32.6%).

Discussion

The contribution of the three alveolar nerves to the maxillary teeth innervation has been different as reported in the literature. Posterior superior alveolar nerve supplies the upper molars and the middle superior nerve supplies upper premolars. The incisors and canines are supplied by the anterior superior alveolar nerves but Robinson and Wormald showed wide variations in the branching pattern of the anterior and middle superior nerve supplying the anterior face of the maxilla. Perhaps this has made clinicians modify their approach to avoid anesthetic procedure failure [8].

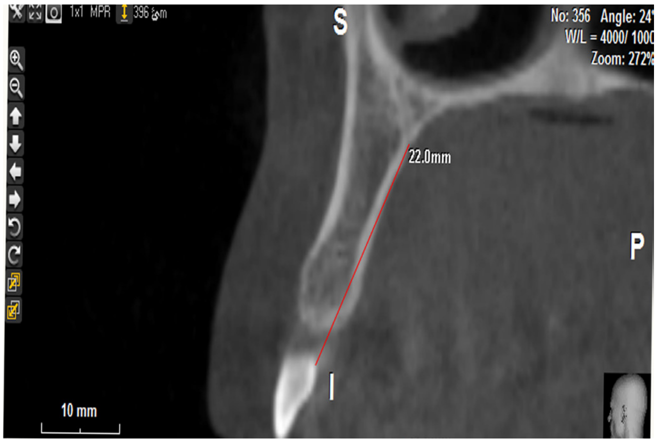

Figure 1. CBCT showing the distance of palatal canal from the cementoenamel junction of canine.

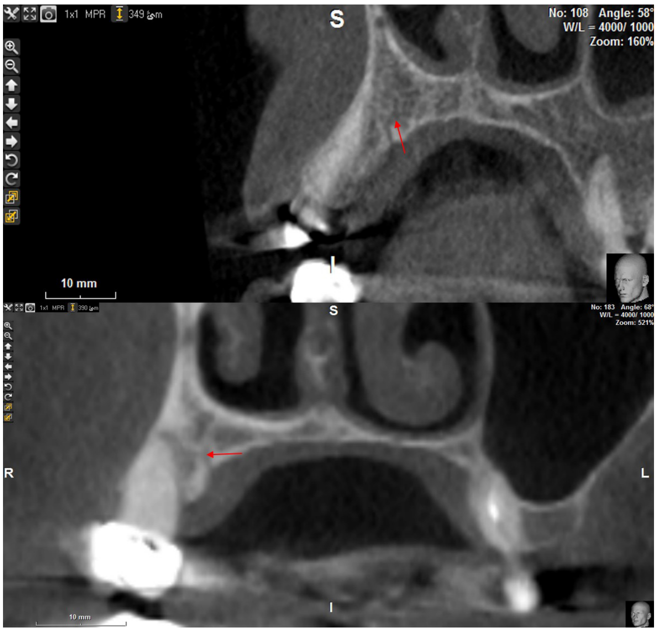

Figure 2. Bifid palatal canal observed in canine and premolar region.

The AMSA injection derives its name from the ability of technique to supposedly anesthetize both the anterior and middle superior alveolar nerves. This injection covers large maxillary surgical fields and reduces the collective number of necessary injections. AMSA technique anesthetizes the buccal tissues from the palatal aspect by maintaining the upper lip functions which does not occur in traditional anesthetic technique [4].

Most of the studies on the incidence of palatal canal have been done using cadavers but its clinical efficacy reported only modest success rates ranging from 35% to 58%. An unpublished reaction survey conducted at Department of Dental Hygiene, Eastern Washington University, during 2003 to 2006 suggested that much higher success rates are possible. While slightly more than 80% of students reported success with the tech-

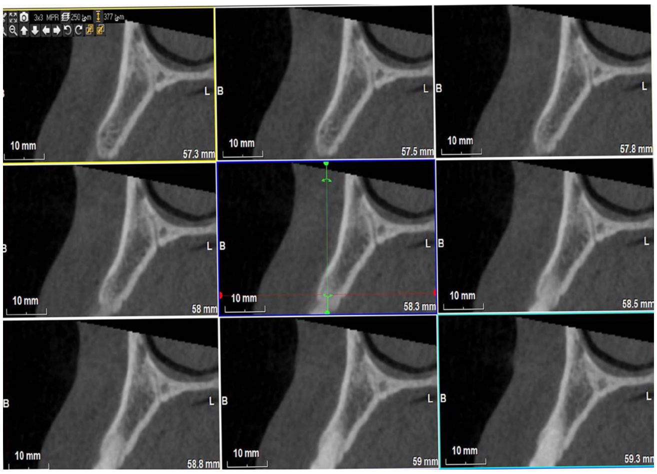

Figure 3. Clear canal from the palatal aspect to the dental plexus near premolar region.

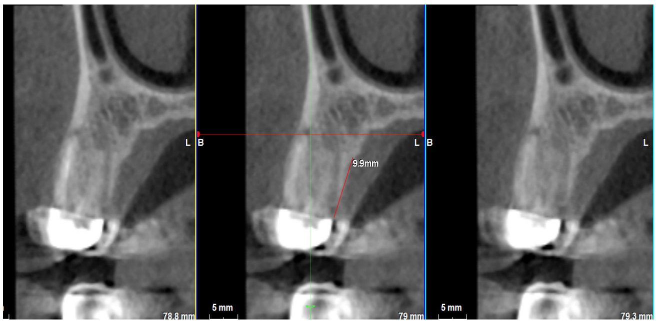

Figure 4. Position of the canal at upper level from the tooth apex.

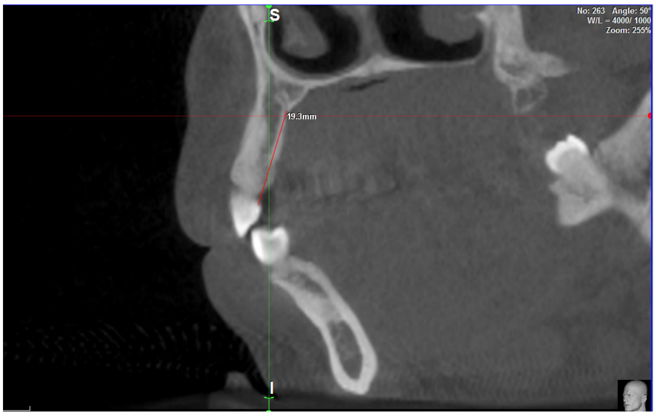

Figure 5. Position of the canal at the level of tooth apex.

Figure 6. Position of the canal at the lower level from the tooth apex.

nique, 98% of the students who completed the survey indicated that they intended to use the AMSA block in the future [9]. The present study focused on analyzing the presence and shape of the palatal canal through limited CBCT radiographic technique.

For anesthesia through the palatal approach it has been suggested that the maxillary sinus and the nasal aperture cause the convergence of the anterior superior alveolar nerve, middle superior alveolar nerve, and the subneural dental plexus at the region of the root apices of the premolars. Hence, at this point the anesthetic solution is deposited, which can diffuse through the palatal bone and small canals to anesthetize the dental neural structures. In the present study, CBCT was done to assess the palatal foramen and canal and its level and shape from the apex of the teeth (canine and premolar) to the dental plexus. We observed that, in most of the subjects, the level of the foramen was at upper level to the tooth apex. Bifid canal was observed which creates 'Y' shape near the dental plexus (Figure 2). The clear (non-branching) canals were also appreciated in other subjects (Figure 3). The branching/non-branching pattern and level of foramen (upper and lower and at the apex) observed in our study might be one of the causes of achieving either successful AMSA anesthesia or AMSA with buccal infiltration mentioned so far in the literature (Figures 4, 5, and 6). Through our observation from the study we could propose that the success of AMSA is dependent on the presence of foramen predominantly in upper level, in the premolar region and with clear/non-branching palatal canal to the dental plexus. Whereas failure could be possibly due to bifid canal near the plexus, presence of foramen exactly is at the apex or below the level from the teeth apices and predominantly in the canine region compared to the premolar region.

This anatomic structure is frequently observed as fine linear, slight curvilinear, or bifid radiolucencies situated within the interproximal alveolar bone of premolars or canines or inferior or superior at the root apices. Thus, the anatomical awareness and knowledge of canal could play an important role in successful anesthesia and prevention of postoperative sensory disturbances. Tomographic technique provides adequate information concerning the overall shape of the palatal region. In addition to the optimum image quality, the excellent geometric accuracy and the low radiation dose, together with the ease of handling, make cone beam computed tomography (CBCT) a suitable system prior to treatment planning of the anterior maxilla [10-13]. The present study describes the good visualization and appearance of palatal foramen and canal on CBCT scans of maxilla.

In conclusion, confirmation of the existence of distinctive nature of palatal canal could avoid multiple injections in the maxillary regions of few of the selected cases due to its varied appearance. In the evaluation of precise dentoalveolar anatomy limited CBCT is very effective to assess the neurovascular structures, accessory canals, and other minor nutrient canals. Also, further anatomical studies using CBCT, focusing on the canal shape and position, are required for better knowledge along with clinical trials in patients with traditional AMSA technique, which could be an alternative for infraorbital nerve block.

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Conflict of interest statement

The authors have no conflicts of interest to declare.

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