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CORONOID FORAMEN
A normal anatomical variation…? Or a pathological entity…?

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ABSTRACT:

Background: The anatomical variations are errors in the embryologic developmental timing or the persistence of normally obliterated structures. The mandible is a U-shaped pivotal structure, considering the attachment of the muscles of mastication. The coronoid process is a variably beak like projection at theanterosuperior aspect of ramus with the anterior border convex and continuous with that of ramus. Posteriorly, it is slightly concave which contributes to mandibular notch. A foramen on this prominent bony structure of coronoid region is known as coronoid foramen.

Aim: To evaluate the prevalence of the coronoid foramina using Cone Beam Computed Tomography (CBCT).

Material and Methods: The study comprises 500 subjects with different ages who have undergone CBCT evaluation for various diagnostic and therapeutic needs. The data obtained

from these were evaluated for the presence of coronoid foramina in sagittal, cross-sectional, and three-dimensional images.

Results: 55 coronoid foramina were observed in 500 patients. All foramina were located on the medial aspect of the mandibular ramus below the coronoid process. Of the 55 , 69% were present bilaterally; 31% were present Unilaterally. Regarding gender 40 were males and 15 were females. Age range varied with 20-40 years were of 45%, 40-60years were of 42%, and above 60years were 13% in number.

Conclusion: The present study gives a fair knowledge of the position of coronoid foramen and its incidence, the presence of which can lead to a challenge in achieving proper anesthesia for regular dental procedures. The treatment plan may also need to be altered in various oral and maxillofacial surgeries considering the presence of neurovasculature occupying such foramina to avoid unexpected complications arising in terms of bleeding and postsurgical paraesthesia which mayeventuate with the involvement of such content of foramina. Therefore, it is imperative for all the clinicians to have an understanding of anatomical variations, as they may potentially thwart a clinician from achieving successful treatment objectives.

Keywords: Coronoid foramina, Accessory foramina, Cone-beam computed tomography, Variation.

INTRODUCTION:

The mandible is one of the largest, strongest bone of the face where numerous morphological features may show changes ascribed to various factors like age, gender and ethnicity. This is the only bone in the skull, with the exception of tympanic ossicles, that is capable of separate movement and is importance for chewing, speech and in regard of esthetics. It is made of acurved body that convexes forward and has two broad rami that ascend posteriorly on each side. Each ramus consists of two processes – coronoid and condyle. The inferior alveolar canal (IAC) also known as mandibular canal, is located in the internal facet of the mandible and contains the inferior alveolar nerve, artery and the vein.The exact location of the mandibular foramen is often difficult to be established even on radiographs due to its radiolucency and the superimposition of contralateral mandibular structures and is of clinical significance to the dental surgeons and oncologists as it isconsidered to be themost reliable reference point for approaching the inferioralveolar nerve in several anaesthesia techniques and spread of cancer.

All unnamed openings in the facial bones are called accessory foramina/canals and their distribution is variable and are named accordingly.Accessory foramina in the mandible are constant structures of humans. The variations can be unilateral or bilateral, majority of the times bilateral symmetry is common but variations exist in size, shape and number. Nerves, neurovascular bundles, arterioles and venules occupy the accessory canals and foramina[2]. Knowledge of accessory foramina,their position and incidence, will be helpful for dental surgeons to achieve complete anesthesia and also prevent injury during any surgery.

One such accessory foramen in the mandible located near the coronoid process is the coronoid foramen. The cognizance of the presence of such foramina is clinically important as they can lead to diagnostic and therapeuticmisinterpretations. The outlandish of these anatomical variations and their presence can have adverse implications with added complications in the performance of surgical proceduresresulting in procedural changes while operating and surgical planning to avoid failure in anaesthesic techniques, also operative complications and its inference thereafter. The diagnostic problems and treatment risks associated with this foramen can be avoided by through knowledge and its detection in radiographs.

The use of radiologic imaging for detecting coronoid foramen with low-dose conventional radiographs such as intraoral radiographs and panoramic radiographs is limited and do not stand with the required accuracy and reliability. Nevertheless panoramic imaging can help spot the foramen. Cone beam computed tomography (CBCT) has an advantage over conventional radiographs not just in viewing the anatomical structures 3-dimensionally but also in overcoming the limitations of 2D images like structural superimpositions, it permits precise location and measurement of foramen.

Many studies have reported the variations in the mandible, but, a probe into the literature revealed very few studies regarding based on findings of 'foramina on the coronoid process' in mandible, therefore this present study isaimed to evaluate the presence of the coronoid foramina using cone beam computed tomography (CBCT).

MATERIALS AND METHODS:

This retrospective study included 500 patients of variable age group and gender procured from the Department of Oral Medicine and Maxillofacial Radiology, SVS institute of Dental Sciences, Mahabubnagar, India from september 2019 to march 2020 for the purpose of radio-diagnosis using CBCT.

The inclusion criteria are patients who were referred to the department for CBCT scan of 16 x18 fov for different dental ailments.

The exclusion criteria are individuals with maxiollofacial trauma and pathologies where it could lead to misinterpretation.

The study was compassed after the approval of Institutional Ethics Committee.

CBCT imaging were acquired through a machine of Dentium make with a standard 90kvp, 8mA and FOV of 16x18cm with 3D head rest method in standard position. The volumetric data obtained is then analyzed using Rainbow software. From the obtained CBCT images the coronoid foramen will be located separately for right and left side in axial, sagittal and 3D volume rendering images.

The results obtained were recorded and tabulated. Frequency distribution and descriptive analysis were done.

RESULTS:

The topographical distribution of the accessory foramina are summarized in Figure 1-4. The foramina were observed in 55 cases (11%) {Figure 1}. Of the 55 , 38 were present bilaterally (69%) {Figure 2}; 17 were present Unilaterally(31%) {Figure 3}. Of unilateral 10 were present on Right (18%), 7 onleft (13%) {Figure 4}. Regarding gender 40 were males and 15 were females{Figure 5}. Age range varied with 20-40 yrs were of 25(45%), 40-60yrs were of 23(42%), and above 60yrs were 7(13%) in number. {Figure 6}

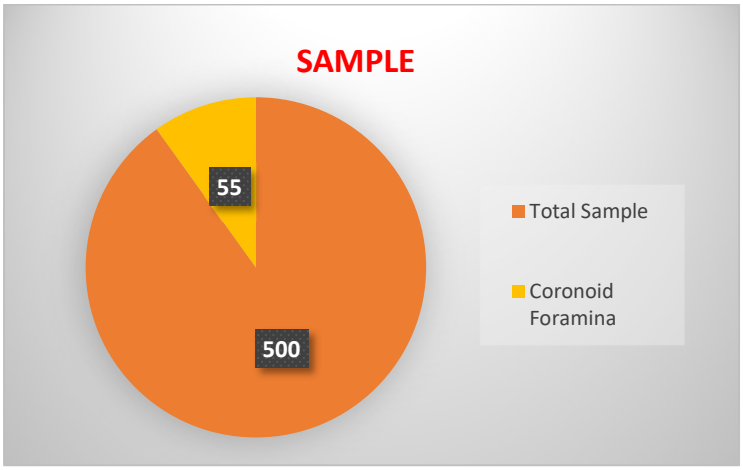

Figure: 1 Prevalence of coronoid foramina

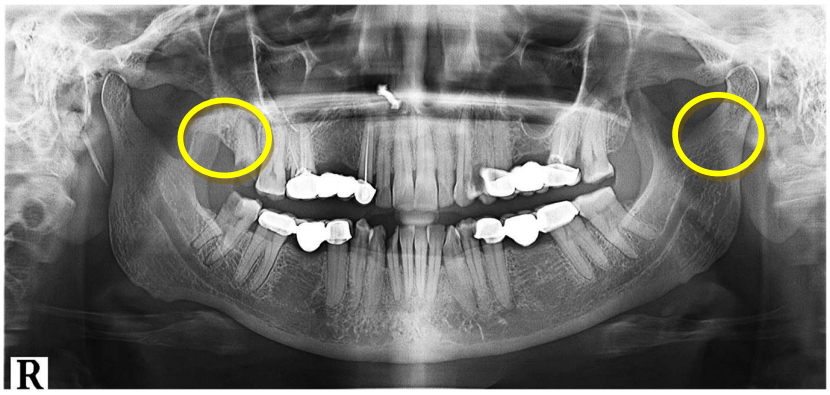

Figure: 2 Bilateral coronoid foramina

Figure: 3 Unilateral coronoid foramina

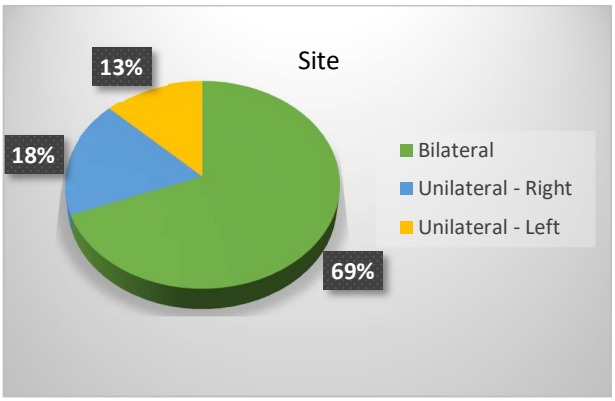

Figure: 4

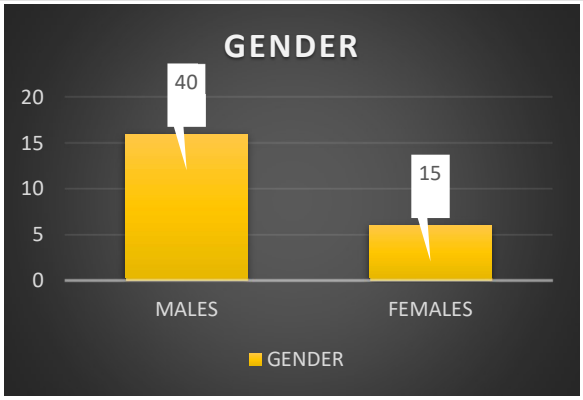

Figure: 5:

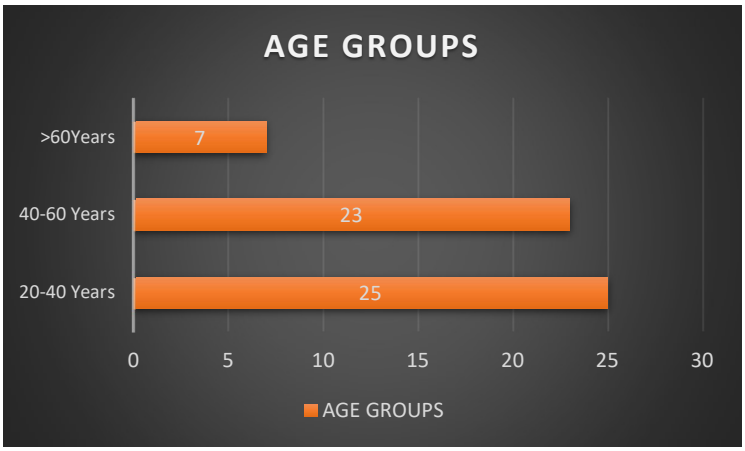

Figure: 6

Figure 4-6: Topographical distribution of the presence of coronoid foramina, its site, gender and age groups respectively.

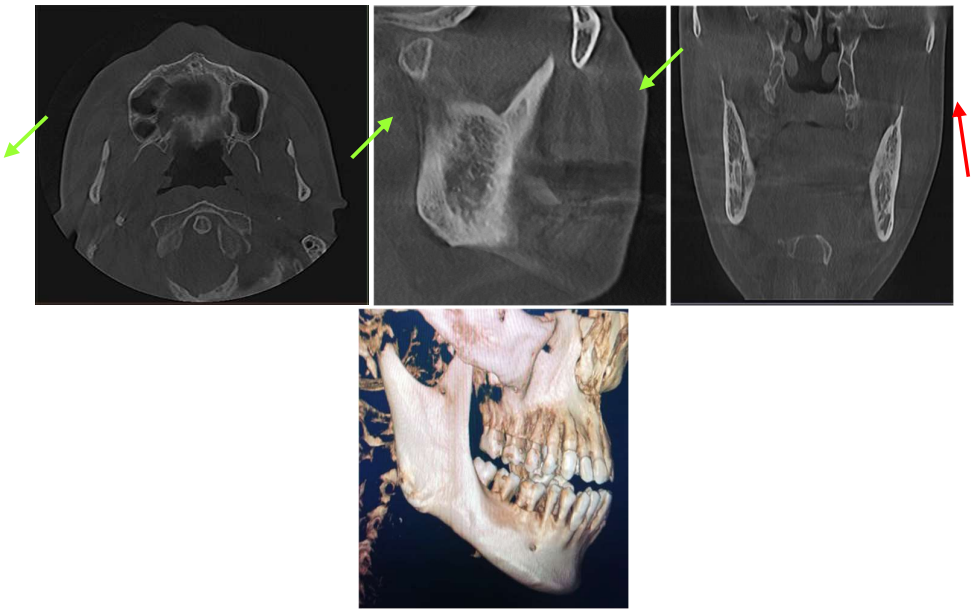

Figure: 7 Different sections of CBCT

DISCUSSION:

A variation can exist in man which produces a structural character which is cognate with what is seen normally in another animal group. The variation may be truly erstwhile, but for all that it does not follow, as a matter of course, that it is genetically related to the synonymous character in the animal group[3]. According to Cunningham, the anatomical variations are errors in the embryologic developmental timing or persistence of normally obliterated structures. They can fall into either of two categories: retrospective and prospective types. Retrospective anatomic variations appear at much unexpected places. The prospective type is often most vague, yielding evidence and direction towards which the phylogenetic evolution is tending. A critical period that occurs in the development of the primate cerebrum is between the 3rd and 4th months of fetal life[6].

Craniofacial development is a complex process necessitating the integration of several specialized differentiated tissues, such as the surface ectoderm, neural crest, mesoderm, and pharyngeal endoderm. Development of the lower jaw takes place from the paired mandibular prominences, mainly between the fourth and eighth weeks of gestation,. During the fourth week of gestation, prominences are produced by the proliferation of the neural crest cells that migrate into the arches from the neural crest. Neural crest cells of the mandibular primordia arises mainly from the region of the anterior rhombencephalon and gives rise to the connective tissue components, including cartilage, bone and ligaments in the facial and oral regions[7]. Diet has an impact on the muscular pullon bonyprocessandcan drastically change how the coronoidprocess appears. At birth, the coronoid process extends above the level of condylar process and with growth, it comes to lie at lower level inadults.An alteration in the morphology of the mandible may be caused by disorders affectin g lower jaw formation. For example, hyperactivity of the temporalis muscle may lead

to reactive elongation of the coronoid process. Other causes may include trauma, genetic and family factors[7].

The coronoid a clinical significance to the maxillofacial surgeon for its use in the reconstruction of osseous defects in oral and maxillofacial regions such as alveolar defects and orbital fractures as it is a membranous bone.No functional limitations are apparent after removing the coronoid process[8]. The anatomical variations in coronoid process is clinically important as they can lead to diagnostic and therapeutic misinterpretations. Their presence can also have adverse implications with added complications in the performance of surgical procedures also lead to failure in the plan of anaesthesia in dental and maxillofacial practice and these accessory foramina could play an important part in bony invasion which leads to tumor infiltration[3].

The presence of accessory foramina is frequently overlooked in clinical procedures. It is important to note that these anatomical variations should be assessed preoperatively by radiographs and such observation might have influence on the therapeutic success. The available literature suggests, that the variation is a possible reflection of what is found in other mammals. The coronoid foramina have never been documented in humans as yet or in other Proboscideans excluding Elephantines. Feretti andDebruyne suggested thatElephasmaximus had an alveolus which connected to the coronoid canal of the distalmost erupting molar in 2011; this was originally interpreted as a synapomorphy of Paenungul(6).

The present studyhas validated these discoveries in a live patient as attributing to the existing natural phenomenon of almost all the known foramina. These foraminamay also be occupied by the neurovascular bundle like all other accessory foramina.

LIMITATIONS:

- Large sample has to be included
- Neurovascular bundle is not assessed

CONCLUSION:

Although it is rare, the variations in the shape of coronoid process are clinically important for dental surgeons.A thorough radiological examination can help to rationalize the line of management and the ultimate clinical outcome. Three-dimensional images of CBCT data are useful in confirming the presence of coronoid foramen leading to the anatomical variation which may cause diagnostic and therapeutic misinterpretations and also cause a failure in the plan of anaesthesia in dental and maxillofacial practice. Therefore, the anatomical variation should be carefully investigated using CBCT images in planning of dental surgery.Hence this study has proved that it is a normal anatomical variation.

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