Stomatologija. Baltic Dental and Maxillofacial Journal, 23: 16-21, 2021

"Accessory coronoid foramen" synchronous with "bilateral coronoid foramina" and double mandibular canal – distinctive triad of mandibular anatomic variants in a live human, CBCT exploration

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SUMMARY

This manuscript, aims to present a rare case of accessory 'coronoid foramen' with bilateral coronoid foramina and double mandibular canal along with accessory foramen over the 'lateral aspect of the ramus of the mandible' in a 36 years old Saudi female patient, which has never been envisaged before as far as the literature is concerned.

Key words: coronoid foramina, coronoid canal, accessory coronoid foramen, mandibular foramen, mandibular canal.

INTRODUCTION

So far in the anatomic science, no discovery was ever so possible without an exhaustive search of literature and likewise the author with his understanding believes that it is also almost impossible to re-discover without a painstaking research. The author in the following manuscript rationalizes his discovery of 'coronoid foramen' by emphasizing the interconnection between Cladistics-Phylogenetic-Synapomorphy hypotheses. Hennig's (1953) (1) terms synapomorphy and symplesiomorphy are necessary and sufficient for the evolutionary interpretation of character states. These terms refer directly to the historical process of speciation character transformation (phylogenesis). A suggestion of a new term "synmorphy" is made because it can well be applied also to those characters where one state represents the absence of a structure/organ (1). This therefore explains the importance of delineation of few transformation series (characters) in the morphologolical cladistics.

A fairly decent literature has focused on the accessory foramina on the mandibular nerve canal and the mental foramen in the mandible. Accessory foramina in the human mandible were found to be constant structures. Przystanska and Bruska (2) in 2010 described numerous foramina located on the posterior aspect of the mandible along with the presence of nerve fibres around the artery in the lingual accessory foramina. Accessory foramina in the mandible are an anatomic variation resulting from mandibular agenesis which include the presence of a lingual foramen, retromolar foramen, double mandibular foramen, or accessory mental foramen are eventually very difficult to detect using panoramic radiography (3).

The low position of the mandibular foramen with its crescent-shaped outline; the occurrence of a coronoid foramen (canal); the occurrence of two lateral mental foramina, the posterior one at the level of (or slightly behind) the posterior margin of the symphysis, the anterior one in a more anterior position are the characteristic features of primitive Proboscideans (4). The presence of coronoid foramina bilaterally (5) in humans with a phylogenetic hypothesis is documented and available as single evidence till date in literature. The technological advent of CBCT in dentistry enables the maxillofacial surgeons in easy identification of accessory foramina, canals and its study can be used to guide the clinician to perform pre-surgical analysis, planning for orthognathic procedures, implantology and extractions of impacted teeth and so forth. The following manuscript is unique as it presents an accessory coronoid foramen with a coronoid canal along with bilateral coronoid foramen.

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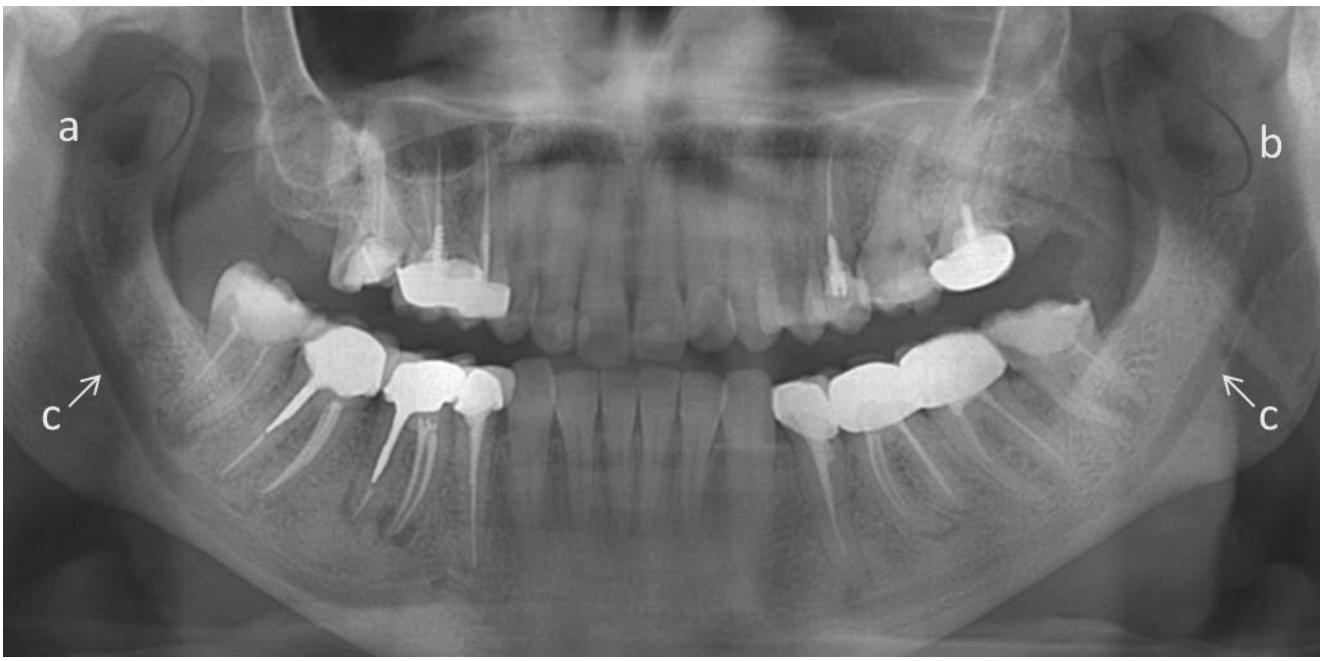

Fig. 1. Panoramic radiograph revealed an unusual radiolucency on the coronoid processes bilaterally (a &b circles); c – inferior dental canal

It also presents two other uniquely interesting and rarely documented anatomic variants such as double mandibular canal along with accessory foramen on lateral aspect of ramus of mandible.

It therefore becomes pertinent for every oral maxillofacial surgeon to be familiar with the anatomy and rare anatomical variants of the head and neck region since there is a possibility of occurrence of strange, sometimes wonderful or otherwise problematic morphological variations in humans most of the time. The thorough knowledge of possibility of occurrence of anatomical variations may determine the success of procedural anaesthesia, the aetiology of pathologic processes, and the avoidance of surgical misadventure during intervention over the anatomic areas in the head and neck region. The following case presentation not only presents the occurrence of a rare bilateral coronoid foramina but also along with it an accessory coronoid foramen and a coronoid canal, first of its kind in the literature with additional rare anatomic variations such as double mandibular canal along with accessory foramen on lateral aspect of ramus of mandible.

CASE REPORT

This case study describes a 36 year old Saudi female, moderately-built, asymptomatic patient who was referred to the author in department of oral and maxillofacial surgery at a tertiary referral centre for dentistry for extraction of grossly destructed incomplete root canal treated teeth.

Clinical findings

Patient's medical history was non-significant. Extra orally there was no obvious asymmetry of the face. On intra oral examination there were multiple root canal treatment done in relation to 16, 15, 25, 27, 35, 36, 37, 45, 46, 47 & 48 teeth. Exodontia of the 16, 46 & 48 which were grossly destructed with incomplete root canal treatment and periapical pathology followed by implant placement was decided as part of a comprehensive oral rehabilitation plan. The patient's previous dental history involved multiple dental visits and also the repeated failure of dental anaesthesia. Therefore, a detailed clinical examination and clinical interview were performed to implement a systematic approach towards her treatment plan.

Investigations

Routine preliminary investigation such as an Orthopantomograph and complete mouth series intra oral periapical radiographs were performed followed by 3D CBCT scan evaluation.

Panoramic radiographic findings

Revealed an unusual radiolucency in the coronoid processes bilaterally (Fig. 1) which did not co-relate with the normal morphologic feature of mandible. This instigated the author for the need for further evaluation of mandible and the coronoid processes.

Three dimensional cone beam computed tomography (3D CBCT) parameters

A 3D CBCT by Orthopantomograph OP300 scanner with technical parameters: image volume

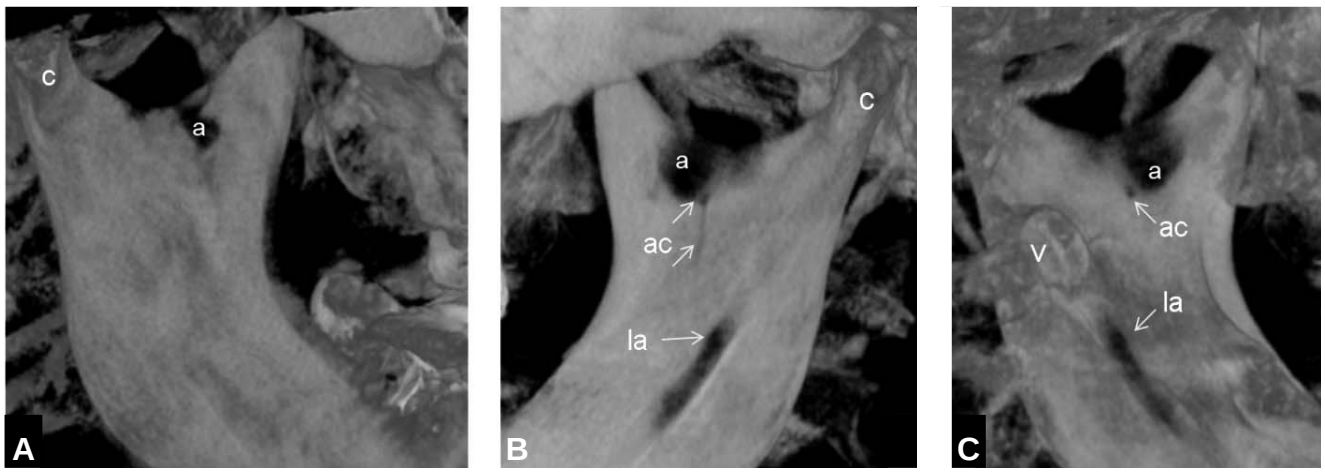

Fig. 2. 3D CBCT image: A – right side, lateral aspect (a – coronoid foramen; c – condyle). B – lateral aspect of left side showing presence of structural variation in the coronoid process and the lateral aspect of ramus of mandible (a – coronoid foramen; c – condyle; ac – accessory coronoid foramen with canal; la – lateral accessory foramen). C – medial aspect of left side showing (a – coronoid foramina; ac – accessory coronoid foramen; la – accessory foramina on the lateral aspect of mandible; v – vertebrae).

size 61×78 mm, tube current 15 mA, tube voltage 80 kV, scan time 16 s, exposure time 12 s pulsed X-ray. The software used was DICOM OnDemand3D from Cybermed, USA, for image acquisition.

Analysis of the 3D reconstruction of this scan confirmed the structural alteration such as presence of large foramina in the bilateral coronoid processes of the jaw along with a small accessory coronoid foramen on the left coronoid process, an accessory foramen on the lateral aspect of the ramus (Fig. 2), which was not consistent with the normal morphology of the mandible.

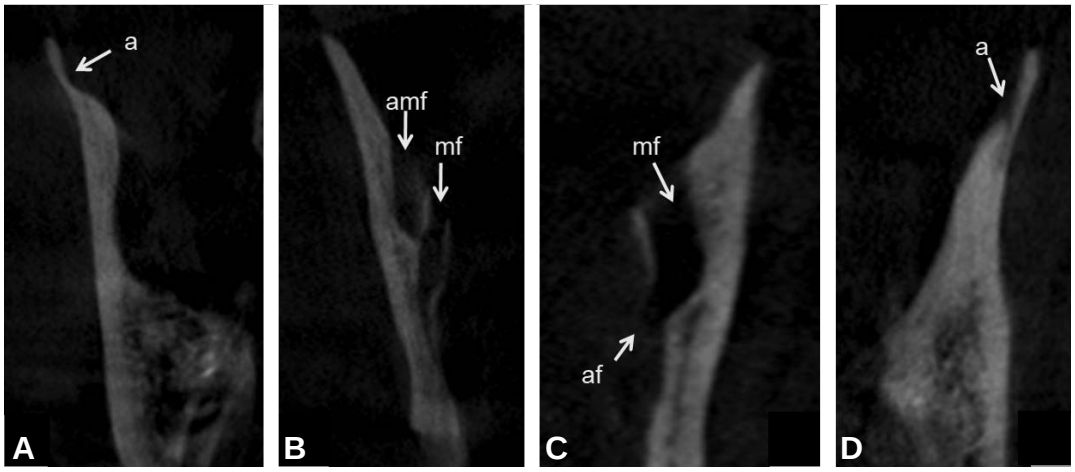

Fig. 3. Coronal section images: A, B – right side of ramus of mandible, anterior to posterior orientation (a – coronoid foramen; amf – accessory mandibular foramen; mf – mandibular foramen). C, D – left side of ramus of mandible, anterior to posterior orientation (mf – mandibular foramen; af – accessory foramen inferior to the mandibular foramen; a – coronoid foramen with accessory coronoid foramen and its canal).

Coronal section of the scan images revealed the presence of coronoid foramina bilaterally with an additional accessory foramen on the left coronoid process only; it also confirmed the presence of a separate large accessory foramen on the right side of mandible medially (Fig. 3), this large accessory mandibular foramen was present lateral to the actual mandibular foramen and was continuous with a separate canal running parallel to the main mandibular canal until the level of mandibular first molar and they converged at the mental foramen region. The medial aspect of the left side of mandible revealed a foramen exiting inferior to the main mandibular canal suggesting a branching of the inferior dental neurovascular bundle. It was interesting to find that the small accessory coronoid foramen on the left side had its own separate canal ending abruptly towards the centre of the ramus of mandible.

The axial section of the scan images also revealed the presence of coronoid foramina bilaterally with accessory coronoid foramen on left side and multiple accessory mandibular foramina along with two separate mandibular foramina continuing to have their own individual canal running parallel to each other (Fig. 4).

The sagittal section of the scan images confirmed the presence of the aforementioned variations in the coronoid processes and the mandibular

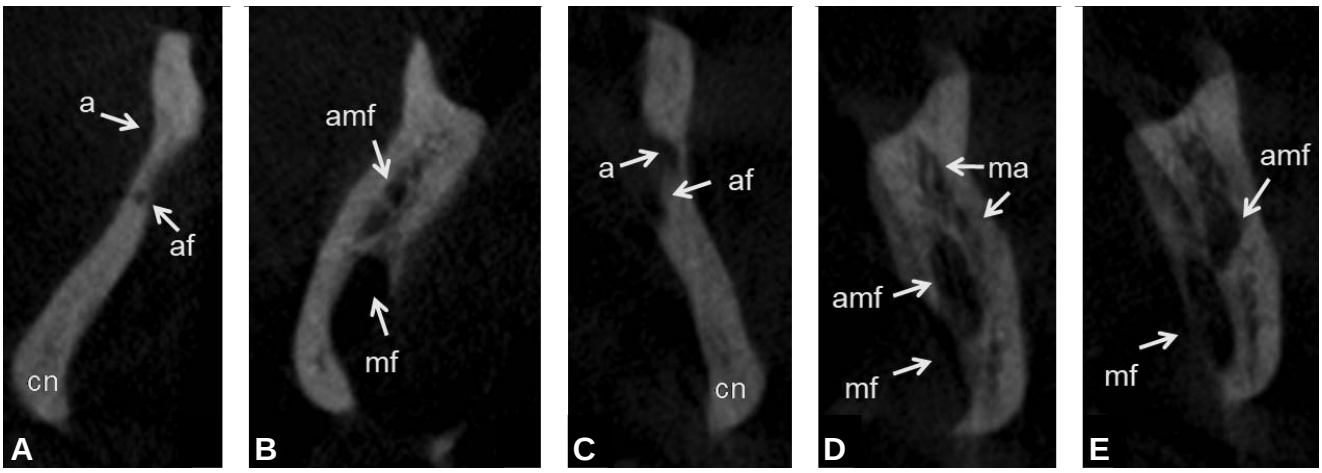

Fig. 4. Axial section images superior to inferior orientation: A, B – of left side of ramus of mandible (a – coronoid foramen; af – accessory coronoid foramen; cn – condyle; mf – mandibular foramen; amf – accessory mandibular foramen). C-E – right side of ramus of mandible (cn – condyle; a – coronoid foramen; af – accessory coronoid foramen; mf – mandibular foramen; amf – accessory mandibular foramen; ma – multiple accessory foramina).

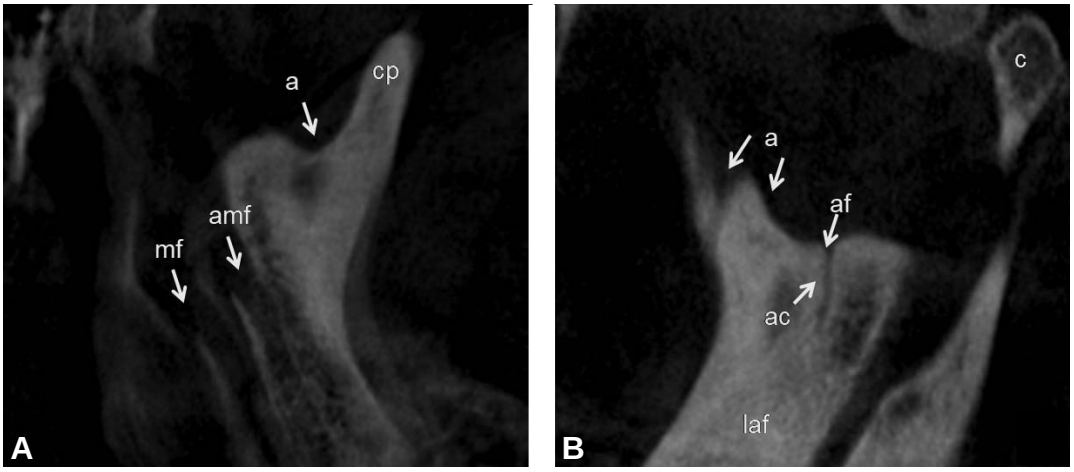

Fig. 5. Sagittal section images: A – right side of ramus of mandible (cp – coronoid process; a – coronoid foramen; mf – mandibular foramen; amf – accessory mandibular foramen; idc – inferior dental canal; aic – accessory inferior dental canal). B – left side of ramus of mandible (c – condyle; a – coronoid foramen; af – accessory coronoid foramen; ac – accessory coronoid foramen canal; idc – inferior dental canal; laf – lateral accessory foramen).

foramina with the presence of two separate inferior dental canals on the right side, a lateral accessory foramen on left side with a small accessory coronoid foramen with its canal ending abruptly (Fig.5).

DISCUSSION

The coronoid canal. **Phylogenetic hypothesis**

The coronoid canal is a rare feature in mammals. Nevertheless, the literature from the previous reports, indicate its consistent appearance only among adult paenungulates and lagomorphs. The presence of this character optimizes as a synapomorphy for paenungulates, as hypothesized by previous authors, and independently also for lagomorphs. A superficially similar structure has been observed in specimens of Potamogale and Elephas that are dentally immature (2).

Ontogeny of coronoid canal

A patent coronoid canal is clearly widespread among living and fossil hyracoids, sirenians, and proboscideans (4). A focus on the soft-tissue contents of this canal of these groups, and on the postnatal osteological changes to the lower jaw in taxa with a coronoid canal and dental eruption well into adulthood are a necessary logical additional steps to further investigate this structure. If the canal were present in taxa by virtue of dental alveoli, then every mammal with erupting teeth would exhibit a "coronoid canal," as tooth eruption necessarily entails passage of the dentition through the mandibular corpus during postnatal development, and any alveolus opening above an erupting tooth would comprise a "canal" between the postero-internal aspect of the lower jaw and posterior tooth row via their mandibular canals. Hence, the presence of an alveolus which in turn connects that space to the oral cavity is not, by itself, synonymous with the possession of a coronoid canal (6).

Synapomorphy phylogenetic hypothesis

The coronoid canal was first identified as a synapomorphy of Paenungulates by Tassy & Sho-

shani (1988) (7). The coronoid canal frequently occurs among stem paenungulates and it forms a synapomorphy for paenungulates (7).

The Mandibular Canal

The mandibular canal begins with the mandibular foramen. This canal, when single, runs arching anteriorly, through the trabecular bone, to the level of the alveolus of the medial incisor (8). All Double Mandibular Foramen's were located vertically above the mandibular foramina and it was hypothesized that the contents of the accessory canal branched from the mandibular nerve before they entered the mandibular canal (6). Embryologically, the presence of inferior alveolar nerve has been presumed as a prerequisite for inducing osteogenesis and the formation of the mandibular foramen and canal. The presence of accessory mandibular canal is of great clinical importance. The contents of the accessory mandibular canals are debatable but since such canals may be confluent with the accessory foramina the presence of a neurovascular bundle cannot be ruled out (2). Double mandibular foramen is considered as an easy route for tumor cell to spread following the radiotherapy. Therefore, the variation should be carefully investigated using reconstructed cone beam CT images in planning of dental surgery or radiotherapy in the mandible (6).

The mechanism of formation of this type of accessory mandibular foramen (AMF) is not known. It is known that the inferior alveolar artery passes through the small-sized AMF located behind the MF during development (2). The accessory foramina on the mandibular buccal surface detected using limited CBCT were all defined as accessory buccal foramina (ABF) regardless of the image findings of the inner bone (9). It may be that similar structure/s develops towards the mandible during its development, finally resulting in the formation of this foramen and consecutively the canal. Regardless of its mechanism of formation, its unexpected encounter would damage the structures passing through it, during surgical approaches in this area (2).

The possibilities with regard to neurovascularisation of the accessory buccal foramen (ABF) would be as following: 1 – a branch of the mental nerve exits the mandible; 2 – a branch of the mental nerve re-enters the mandible; 3 – a branch of the artery enters the mandible. Injury to the accessory mental nerve distributed in the perimandibular region can induce temporary sensory disturbance, such as pain and paraesthesia. There is also a possibility of arterial injury during operation of the perimandibular areas. It is to be considered that the facial, submental, and buccal arteries enter the mandible through the nutrient foramina when considering their general distribution (9).

The mandibular canal is seen to be located at a mean distance of 10.52 mm above the inferior margin of the mandible and the mean maximum diameters of the mandibular canal, inferior alveolar nerve, inferior alveolar artery, and inferior alveolar vein were 2.52, 1.84, 0.42, and 0.58 mm, respectively. The inferior alveolar nerve often gives rise to several branches at each level (range 0-3) (10) and is of most concern if an accessory or double mandibular canal is found. The risk of injury, to these small branches of the nerve is extreme and hence detailed knowledge regarding the position of the mandibular canal and their variants should be taken into consideration when planning mandibular surgery including tanspositioning and lateralization of inferior alveolar nerve for dental implant placement.

CONCLUSION

It should be emphasized that there is a constant recognized possibility of existence of anomaly pertaining to the presence of accessory foramina with accompanying neurovasculature although as a rare occurrence and therefore one should be aware of its incidence, and as a responsible surgeon look at it as everybody looks but also be capable of thinking differently, since the structure/s passing through it could be compromised leading to potential threats during surgical procedures of this area.

Assessing the presence of accessory canals in the mandible is important and should not be ignored. The presence of accessory foramina could probably also help an attending surgeon contemplate as to why few patients still experience pain for mere simple dental procedures despite the adequate anesthesia and near-perfect surgical skills. This manuscript not only provides an addendum to the literature on the existence of a very rare coronoid foramen but also illustrates the presence of an accessory coronoid foramen with a canal in live human. The author finally concludes by analyzing that for all that the author is seen in his anatomic researches, only upskills him to explore further more in depth to confront the divine mysteries of all that he is not seen or yet to be explored.

ACKNOWLEDGEMENT

The author thanks the patient for her kind co-operation in the investigations and the consent rendered to illustrate the findings in the manuscript.

COMPLIANCE WITH ETHICAL STANDARDS

All the findings were incidental and not planned procedural study. The patient was informed about the peculiar findings in her and an informed signed consent was taken with permission to use her data for research publication purposes.

FUNDING & CONFLICT OF INTEREST

There was no funding for this study and the author declares that there is no conflict of interest.

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Received: 19 05 2018
Accepted for publishing: 26 03 2021