Human unilateral bifid coronoid process – Report of a rare accidental radiographic finding

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SUMMARY

Routine panoramic radiographic evaluations reveal morphological differences in the maxillofacial structures, particularly the mandible. Although bifid condyle variants are prevalent, bifid coronoid processes are rarely reported. Here a regular digital Orthopantomograph (OPG) was advised for the patient's routine dental care, which revealed the presence of a unilateral bifid coronoid process on the right side of the jaw, which was confirmed with Cone Beam Computed Tomography (CBCT). This is notable, because it is only the second incidence of its kind to be documented.

Key words: Coronoid process – Anatomical variation – Radiography

INTRODUCTION

The human mandible is the largest, strongest, and only long bone in the skull that has the capacity for separate movement except for the tympanic ossicles and it is anatomically and symmetrically divided into body, ramus, coronoid, and condylar processes bilaterally (Schafer and Thane, 1890). The mandible has a bowed body, which is convex anteriorly, and has two rami that rise posteriorly and have condylar and coronoid processes on both sides (Desai et al., 2014). The coronoid is a thin triangular beak-like process placed anterosuperiorly of the ramus and gives attachment to two important muscles of mastication, the temporalis and masseter, thus emphasizing the morpho-functional dependence. The coronoid process is a membranous type of bone subjected to minimum resorption which can be harvested for local graft, causing less morbidity, no apparent functional limitation, and no cutaneous scarring (Hamilton, 1960). Anatomical and morphological variations have been reported with regard to the shape, length, and width of the coronoid process, and only a few reports mention the bifurcation, or bifid coronoid process. In their letter to the editor, Kansu et al. (1994) mentioned the first instance of the bifid coronoid process in which a detailed description was not given. This article reports a rare instance of an accidental finding of the unilateral bifid coronoid process. Our case may be the second well-documented instance reported in the English literature.

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CASE REPORT

A 58-year-old male patient reported to our outpatient department with a fractured lower back tooth. He had been hypertensive for 15 years, and was on regular medication. He had no other comorbidities. The initial physical examination was within normal limits. His intraoral examination revealed deep caries of 27, 28, with grade 1 mobility and root stumps of 26, 35, 36. He had generalized gingival inflammation with recession and shallow periodontal pockets and exhibited partially edentulous upper and lower arches. A panoramic radiograph (Orthopantomograph, OPG) revealed an interesting anatomical peculiarity in the coronoid process apart from the dental and periodontal pathologies (Fig. 1, showing the bifid coronoid process in the OPG). A CBCT examination confirmed the bifid nature of the coronoid process (Fig. 2 showing the 2-D representation and Fig. 3 showing the 3-D representation of the bifid coronoid process).

DISCUSSION

The mandible, or submaxilla, is a "U"-shaped bone that forms the lower jawline and articulates with the temporal bone on either side. It has a curved body shape with two rami. Each ramus consists of two processes: coronoid and condylar. The coronoid process (from Greek korone, "like a crown") is formed by the extension of the ascending ramus into a thin triangular eminence which is flattened from side to side and varies in shape and size (Nayak et al., 2015). The mandible, thus being strategically located, is commonly affected during inflammation, infections, and trauma. Thus, it is the most commonly radiographed bone in the face.

Recent advancements in trauma imaging, such as CBCT, have paved the way for the detection of variations in the mandible's structural anatomy. Our patient's CBCT image revealed a triangular coronoid process with a bifurcation, consistent with a bifid coronoid presentation, which is defined as "the division of the coronoid process, either antero-posteriorly or medio-laterally, by a cleft/groove/notch that provides attachment to the temporalis muscle". In this instance, the term "bifid" refers to the presence of a bifurcation or groove that divides the coronoid process antero-posteriorly into two parts.

Numerous variations in the shape of the coronoid process have been documented, but few on the double or bifid coronoid process.

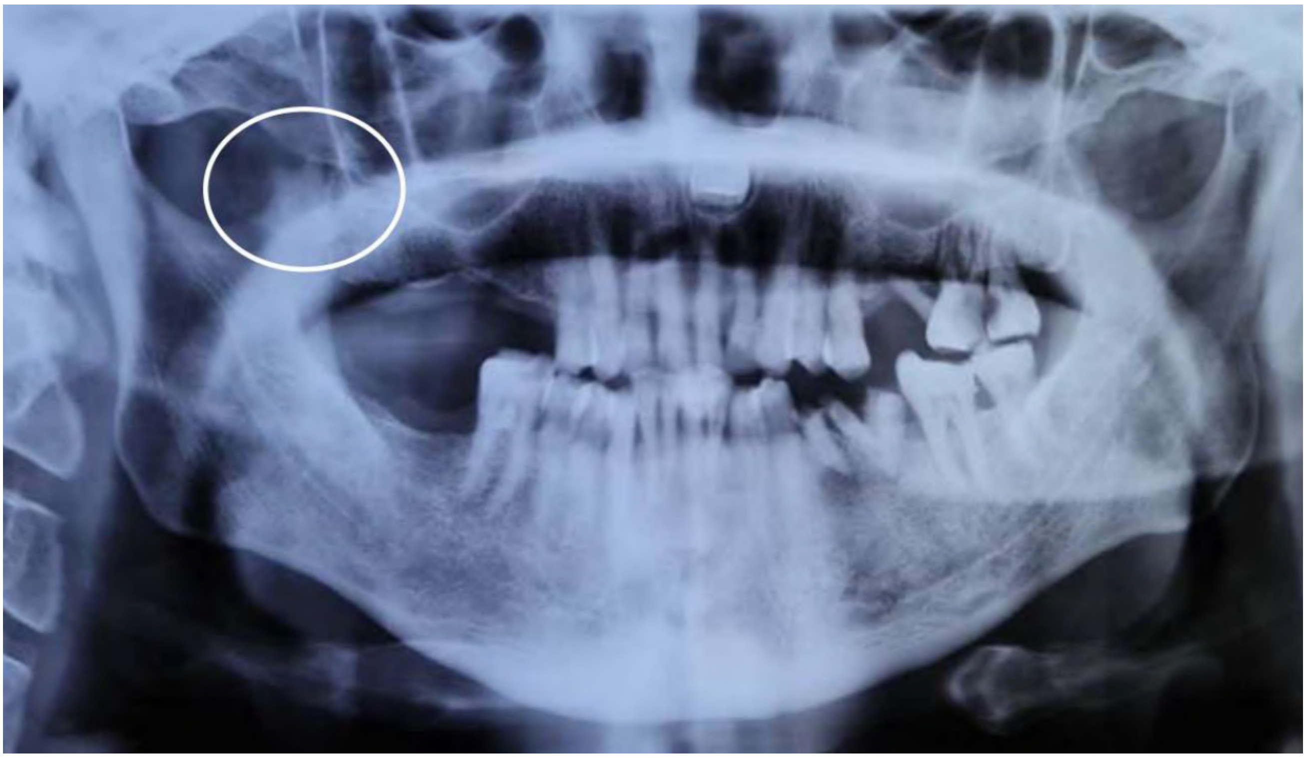

Fig. 1.- The bifid coronoid process in the Orthopantomograph (OPG).

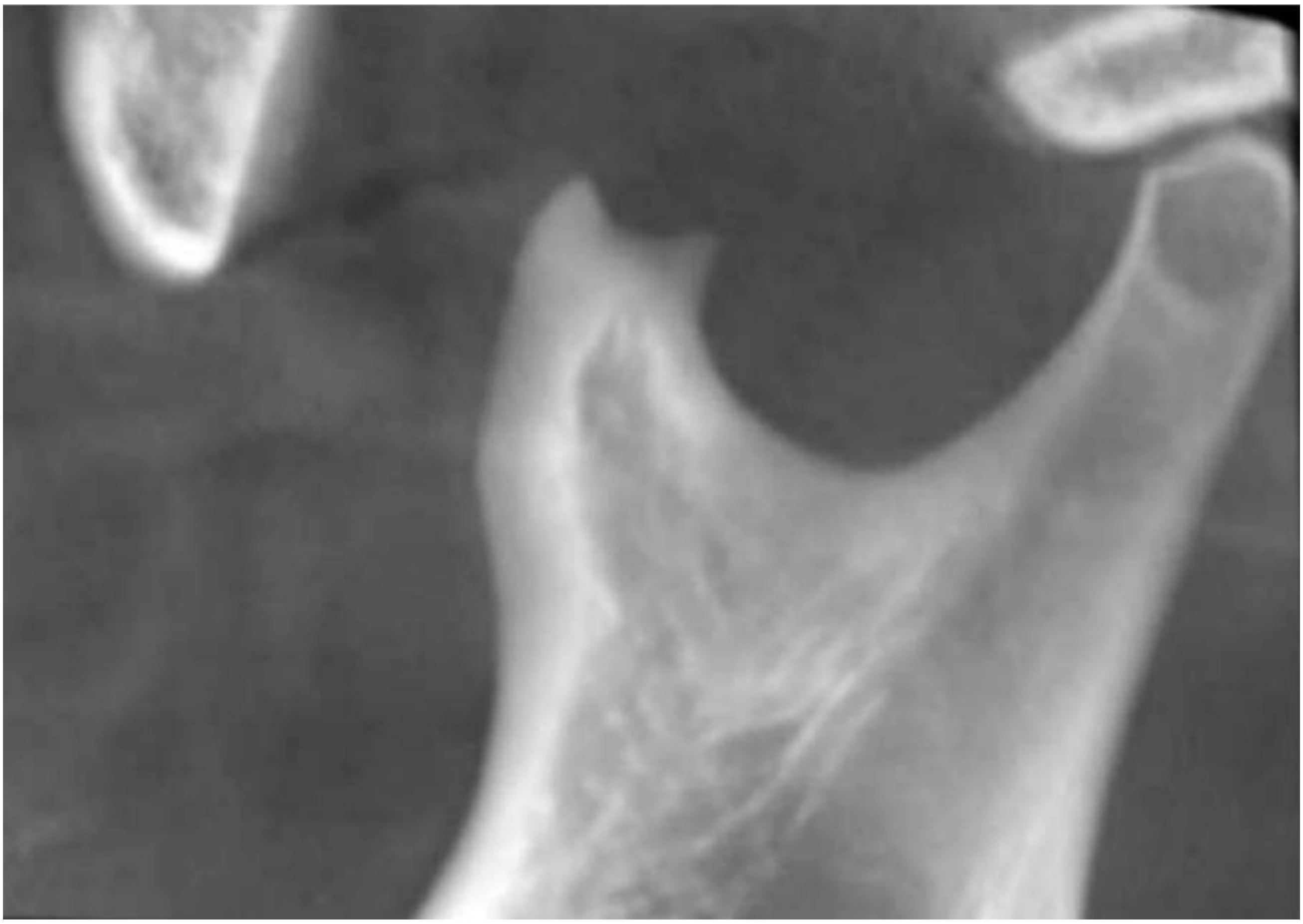

Fig. 2.- 2-D representation of the bifid coronoid process.

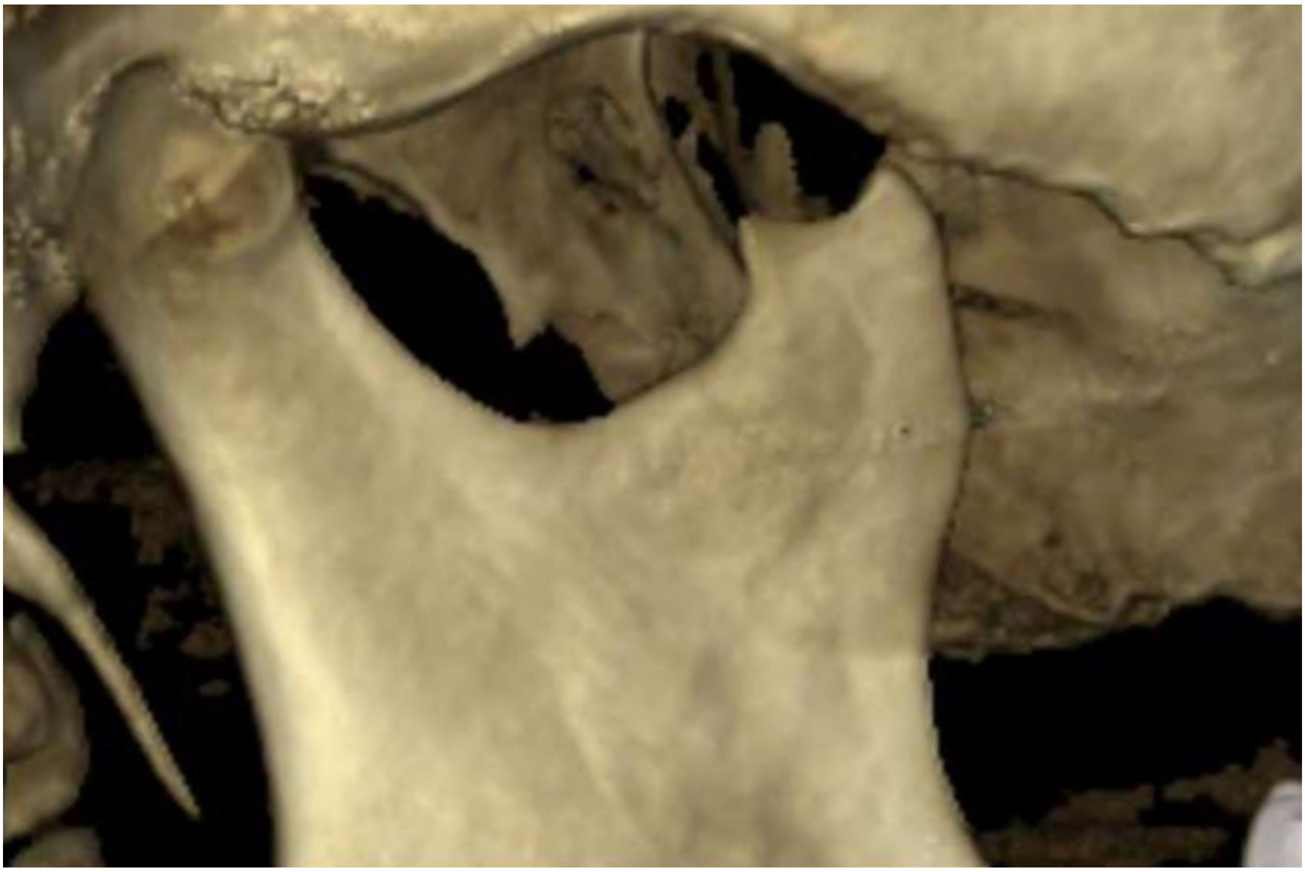

Fig. 3.- 3-D representation of the bifid coronoid process.

The present case is a novice's account of such an occurrence. Earlier, Schafer and Thane (1890) described it as a beak-shaped process in 1915, while Schulz (Subbaramaiah et al., 2015) described it as an S-shaped, undulant, and low-symmetrical process in 1933. The process's sabre-like curvature was attributed to ageing. As a result, a number of authors, including Hamilton and Williams et al (1960) and Basmajian and Slonecker (1989), have referred to it as a triangular process. Additionally, the presence of a double or second coronoid process has been mentioned. According to Isaac and Holla (2001), the coronoid process is triangular, hook-shaped, and rounded. Based on the literature, the following shapes are classified and are described as follows (Fig. 4 shows the schematic representation of various forms of the coronoid process):

Triangular-pointed apex, straight anterior and posterior borders, notch

Hook shaped—pointed apex, convex anterior border, concave posterior border, notch

Rounded – blunt apex, anterior and posterior borders straight, notch absent

Miscellaneous – which doesn't fit into any of them (Subbaramaiah et al., 2015).

Kasat and Bhuiyan (2016), identified hook-shaped coronoid processes (54.5%) as the most common in their analysis of 109 dried mandibles, followed by triangular (23.5%) and rounded processes (17.0 percent). This corroborates the findings by Subbaramaiah et al. (2015). But this was in contrast to other researches, the majority of which were conducted in various parts of India. The triangular shape of the coronoid process was most frequently observed in research by Isaac and Holla (2001) and Desai et al. (2014). According to Pradhan et al. (2014), the coronoid process is most commonly hook-shaped. In their study of 157 mandibles, Isaac and Holla (2001) found that hook-shaped mandibles were 27.4%, triangular mandibles were 49.6%, and rounded mandibles were 23.6%. The author discovered that the rounded type was almost equally prevalent in male and female mandibles, the triangular type was slightly more prevalent in females, and the hook type was more prevalent in male mandibles. Our finding of unilateral bifid corronoid process may be the first well-documented case report following Kansu et al. (1994), who did not include a thorough description in their letter to the editor.

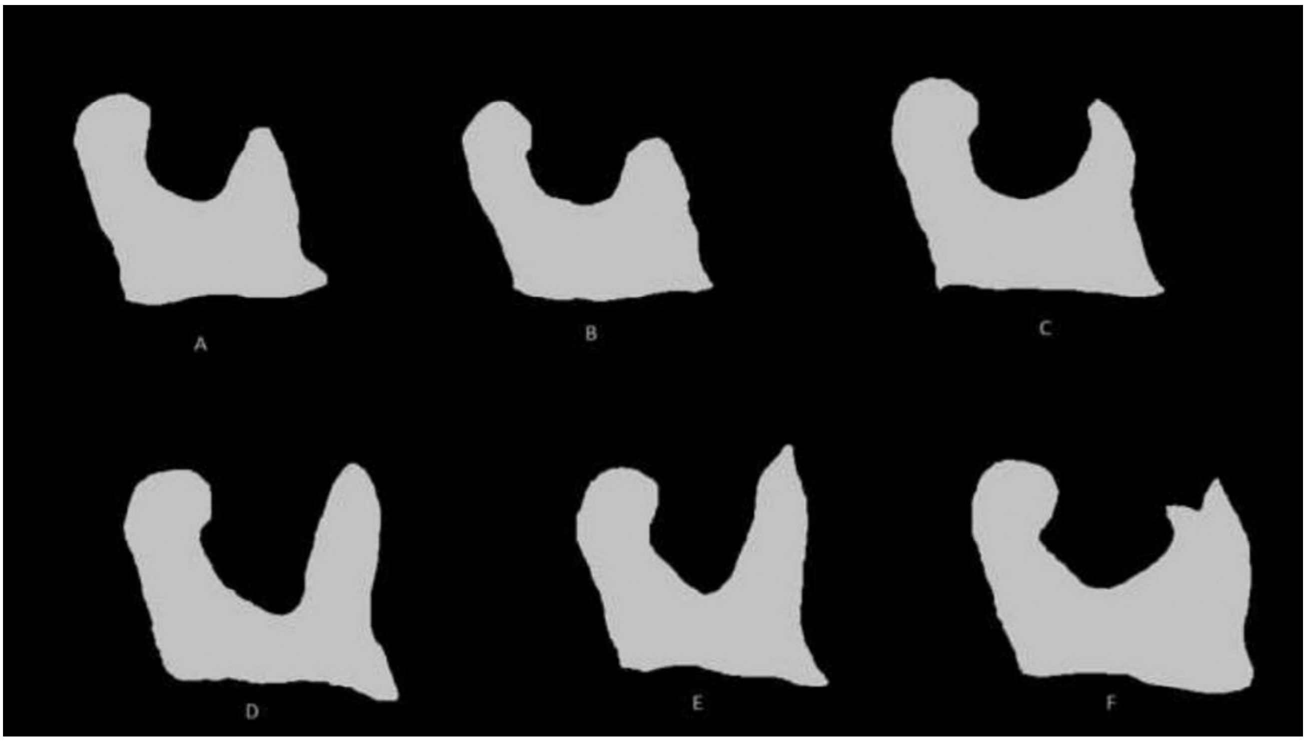

Fig. 4.- Schematic representation of various forms of the coronoid process.

The development of the craniofacial region is a complex process. This requires the integration of multiple specialized tissues, including the ectoderm of the surface, the neural crest, the mesoderm, and the pharyngeal endoderm. The lower jaw develops primarily between the fourth and eighth weeks of gestation, beginning with the paired mandibular prominences. All of these prominences are formed during the fourth week of gestation by the proliferation of neural crest cells that migrate into the arches from the neural crest. The mandibular primordia's neural crest cells originate primarily in the anterior rhombencephalon region and give rise to connective tissue components such as cartilage, bone, and ligaments in the facial and oral regions (Liu et al., 2010). Diet has a significant effect on the muscular pull on the bony process, and can significantly alter the shape of the coronoid process. Occupation and hormones have an effect as well (Jadhav and Vedpathak, 2017). For example, basket makers who frequently weave with their mouths have a larger coronoid process as a result of functional overactivity of the temporalis. Factors disrupting the formation of the lower jaw can alter the mandible's morphology. For instance, hyperactivity of the temporalis muscle results in reactive coronoid process elongation. Additionally, temporomandibular joint dysfunction caused by chronic disc displacement is associated with unilateral hyperplasia. It is mentioned as a factor in the development of Jacob's disease (Jimenez Alvarez and Valdes Reyes, 2020). Additionally, trauma, genetic, and familial factors may play a role. Ankylosing spondylosis has also been linked to mandibular elongation (Bechterew disease) in one study (Wenghoefer et al., 2008). In our patient, there was no previous history, clinical and/or radiological evidence of trauma, hence the cause of this unusual variation could be attributed to the developmental remodeling of the mandible. The cause of this rare variation is elusive, and extensive studies are required in this direction.

The coronoid process is gaining importance as a graft material in all aspects of reconstructive cranial maxillofacial surgeries like orbital floor reconstruction, paranasal augmentation, and temporomandibular joint ankylosis (Mintz et al., 1998). In this regard, there is a need for an understanding of the detailed anatomy and development of the coronoid process. Imaging studies of the coronoid will be a routine, which will report the occurrence of rare variations in the morphology of the coronoid. Different techniques can be used to obtain autologous, allograft, or synthetic bone grafts. Autologous bone grafts are harvested from one area of the patient's body and used in another area of the same person. Because the risks of infection, bleeding, and tissue damage are lower than with allografts, surgeons prefer this method.

Typically, graft bone is obtained from the iliac crest, rib, or calvarium. When the injury is minor, the coronoid process can be used as a graft material. As previously stated, the coronoid process graft has a number of advantages. It is critical to determine that the dimensions of the issued bone are adequate prior to performing grafting operations. In the present case, having a bifid or double coronoid process can be more useful, as one of the two can be spared for its functional adequacy and the other cultured as a graft.

CONCLUSION

The coronoid process is a vital structure in the mandible and exhibits diverse variations in its morphology. Significant differences might lead to difficulty in mastication and a decreased range of movement of the temporomandibular joint. Increased utilization of various imaging modalities will reveal unusual variations of coronoid that have to be reported. This is a prompt report of the incidence under this consideration. The maxillofacial surgeon can benefit from knowledge of the coronoid process's morphological shapes. It is an excellent donor graft site for reconstructive purposes, because it is used to repair osseous defects in the oral and faciomaxillary regions such as alveolar defects, orbital floor repair, maxillary augmentation, and correction of mandibular non-union fractures.

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