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IP International Journal of Maxillofacial Imaging

Journal homepage: www.ijmi.in

Case Report

Gubernaculum dentis – A case report of an additional finding in cone beam tomography

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Abstract

The gubernaculum dentis (GD) is an anatomical feature described in literature as the eruption pathway that connects the dental follicle to the gingiva in permanent teeth. The gubernacular cord, which lies within the GD, serves as a link between the tooth follicle and the overlying gingiva and can be observed in the alveolar region on the lingual or palatal aspect of primary teeth. Cone beam computed tomography (CBCT) is regarded as one of the most effective and reliable imaging techniques for assessing the maxilla and mandible, including the teeth, due to its ability to capture high-resolution images of hard tissues. This report discusses a case involving a 16-year-old female who was referred for a CBCT scan regarding an impacted tooth 23, which revealed a hyperplastic dental follicle associated with the gubernacular cord. Many cases involving the GD likely go unrecognized or are incorrectly diagnosed. Therefore, noting such incidental findings on CBCT is crucial and should be given appropriate attention.

Keywords: Gubernacular dentis, Cord, Canal, Imaging, Cone beam computed tomography, Tooth eruption.

Received: 18-06-2025; **Accepted:** 16-07-2025; **Available Online**: 17-07-2025

1. Introduction

The Gubernacular Dentis/Canal (GD/GC) is an anatomical feature visible on CBCT scans, serving as a connection between the dental lamina of an unerupted tooth and the overlying gingiva at the normal eruption site.[1]

The gubernacular cord (GCo) and canal were first described in 1778 by English scientist John Hunter, who noted a link between the developing tooth's bony ridge and the gingiva. The GC, which maintains continuity between the bony ridge of erupting permanent incisors, canines, and premolars and the overlying gingival tissue, is filled with the gubernacular cord.[2] This cord consists of fibrous connective tissue that contains peripheral nerves, blood vessels, lymphatics, and epithelial cells or clusters originating from the disintegration of the dental lamina.[3]

Epithelial cells within the GCo secrete chemical mediators, such as Epidermal Growth Factor (EGF), which activate clastic cells and promote bone resorption in the surrounding area. The resulting space between the GCo and the alveolar bone forms a narrow passage known as the GC.[4,5]

The most frequent signs and symptoms include the failure of permanent tooth eruption, retention of a deciduous tooth, and the potential for communication with the oral cavity, which may lead to infection. It is important to distinguish this structure from bone trabeculae, medullary spaces, neurovascular bundles, or sinus tracts. As it is

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https://doi.org/10.18231/j.ijmi.2025.012

regarded as a normal anatomical feature, biopsy is not required.[6]

The GCo and GC are believed to play a key role in tooth eruption, directing the developing tooth toward the alveolar process. Despite their significance, these structures have received limited attention in dental practice, and few scientific studies have highlighted their presence or clinical relevance.

The GC is a slender structure, typically measuring 1 to 3 mm in diameter, making it challenging to detect on two-dimensional imaging, such as panoramic radiographs. This difficulty is due not only to its small size but also to the limitations of such imaging techniques, including superimposition and image distortion. However, the GC can be assessed using Computed Tomography (CT).[1, 7] In dentistry, CBCT is the most commonly used modality, offering high-resolution images with lower radiation exposure compared to traditional CT. As a result, CBCT has become a vital diagnostic tool for evaluating the maxilla and teeth, providing clear visualization without the issue of overlapping structures.[8] Oda M et al, clarified the imaging characteristics and reviewed recent studies on the GT, considering the importance of the research.[9]

Henceforth, we present a case of an impacted maxillary left canine with an associated Gubernacular Canal identified on CBCT. This case resonates with the increasing reliance on CBCT. Consequently, we highlight this structure's presence and importance. Clinicians should expect to see it on CBCT.

2. Case Report

A 16-year-old female patient was referred for CBCT imaging as part of the surgical planning for an impacted upper left canine (tooth 23). Her medical, family, personal, and drug histories were unremarkable, and the consent was attained. The CBCT scan was performed with multiplanar reconstruction. The reconstructed panoramic, coronal, and cross-sectional views in the region of the impacted tooth 23 revealed a well-defined, corticated, low-density tract (radiolucent) that was continuous with the dental follicle of the unerupted canine (**Figure 1**, **Figure 2**). Cross-sectional slices (**Figure 3**) showed that this tract extended from the follicular space of tooth 23, running laterally along the alveolus in the region of the retained primary tooth 63, toward the labial cortical plate, and terminating at the alveolar crest. The sagittal view also demonstrated a radiographic continuity of the follicular space of the impacted canine extending through the bone to its inferior point at the alveolar ridge (**Figure 4**). This tract was interpreted as most likely representing the gubernacular canal, as it aligned with the expected eruption pathway of the tooth. Differential diagnoses considered included a sinus tract, accessory canal, and nutrient canals.

Figure 1: Reconstructed coronal image showing impacted 23 with the gubernacular canal (yellow arrow)

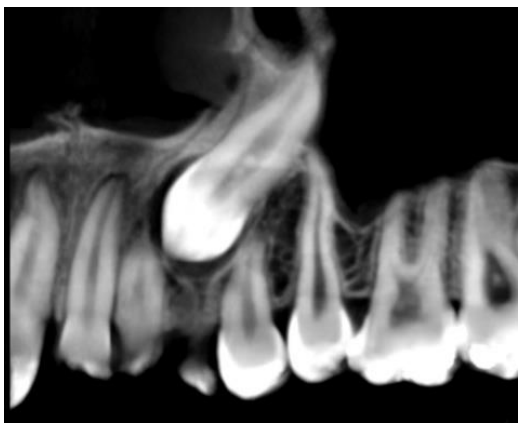

Figure 2: Panoramic image showing impacted 23 with continuous follicular space with gubernacular chord (yellow arrow)

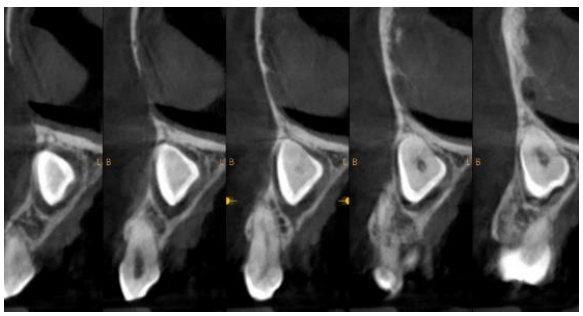

Figure 3: Reconstructed cross-sectional series showing impacted 23 with the gubernacular canal (yellow arrow)

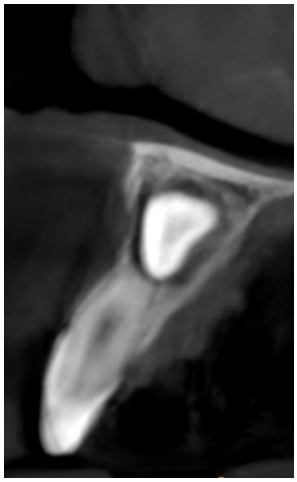

Figure 4: Reconstructed sagittal section demonstrating impacted 23 and gubernacular canal (yellow arrow).

3. Discussion

The gubernacular canal, which contains the gubernacular cord, is an anatomical structure that extends from the dental follicle to the alveolar bone crest, located behind the primary tooth. This complex is believed to play a key role in the eruption of permanent teeth, acting as a pathway guide during the eruptive process. Additionally, it may be involved in the etiology of odontogenic tumours.

As such, understanding and identifying this canal through diagnostic imaging, particularly CBCT, is important in dental clinical practice. It aids in the early detection of tumours and eruption-related abnormalities, facilitating timely intervention when needed.

During the eruption phase, as the successor tooth progresses axially toward the oral cavity, the gubernacular canal is enlarged by local osteoclastic activity to make room for the crown of the erupting permanent tooth. As the tooth advances toward the oral mucosa, the pericoronal follicle integrates epithelial islets and strands from the gubernacular cord into its connective tissue, resulting in a gradual increase in the epithelial content within that region.

According to Hodson, the gubernacular cord was identified only in association with permanent teeth, specifically about their deciduous predecessors, and not with the primary dentition itself. However, Scott observed that even permanent molars, which lack a deciduous predecessor, possess gubernacular cords connecting their follicles to the oral mucosa, referred to as "molar gubernacular cords." Philipsen proposed that the gubernacular cord might play a role in the development of adenomatoid odontogenic tumours (AOT), as it contains remnants of the dental lamina. These epithelial remnants, situated near the crown of the permanent tooth, may migrate along the gubernacular canal during eruption and potentially initiate AOT formation.[4,7] On CBCT, GD shows up as a low-density corticated tract that is next to the dental follicle of an unerupted tooth.7

Ahmed J et al., documented a rare case highlighting the presence of the GC visible on an intraoral radiograph, and emphasized the role of CBCT in clearly defining the canal's extent and orientation.[10] The study also noted that the GC may pose a potential risk for the development of AOT. Therefore, incorporating CBCT in preoperative evaluations can enhance diagnostic precision by visualizing the full extent of the canal in multiple planes, aiding in more effective surgical planning for the extraction and complete removal of the associated gubernacular tissue.

In 2015, Moreira FDS et al., reported a case involving an 11-year-old female, where a routine panoramic radiograph revealed a well-defined radiolucent area surrounding the crown of an impacted tooth, along with a canal extending apically.[11] This was diagnosed as a hyperplastic dental follicle associated with a gubernacular cord. It is believed that many cases involving the gubernaculum dentis likely go unrecognized or are misdiagnosed.

In 2019, L. Almufleh et al., they were the first to report a case of GD associated with a transmigrating canine in a 60-year-old Indian female who presented for assessment before dental implant placement to replace a clinically missing mandibular canine.[12] According to Koc N et al., the absence of GC may indicate a disturbed eruption pattern of the tooth and may increase the risk of complications related to impaction, resulting in a tooth that is more likely to remain unerupted.[13]

Raiyisi M et al, in 2023, analysed CBCT images of 77 impacted permanent and supernumerary teeth from 21 males and 29 females in a cross-sectional study.[8] In addition to the length of the GC, the anatomical surface of the tooth from which the canal originated, the frequency of GC detection, its placement regarding the crown and root, and the surrounding cortical table to which the canal opens were all examined. In 53.2% of the teeth, GC was detected. For 41.5% of teeth, the anatomical aspect of origin was occlusal/incisal, and for 82.9%, it was crown. Furthermore, 63.4% of canals were not situated along the tooth's long axis, and 51.2% of GCs opened in the palatal/lingual cortex. Lastly, 85.7% of teeth going through the crown development stage had GC identified.

Whereas, Gomes CEDVS et al, correlated the eruptive delay of permanent teeth in individuals with Down's syndrome (Ds) and the GC through CBCT.[14]

Almoosa TS et al. conducted a study to assess the detection rate and morphology of the gubernacular canal (GC) in impacted and unerupted canines, and to determine if there were any differences in GC characteristics between the two groups.[15] The study found that the overall GC detection rate in impacted/unerupted canines was 80.3%. Among these, 8.9% showed shape alterations, over half had their opening on the palatal or lingual side of the alveolar crest, and 59.1% were abnormally attached to the dental follicle. No statistically significant difference was observed in GC detection between impacted and unerupted canines or between genders. The detection rates were 78.4% in females and 83.5% in males, respectively.

Elsayed LK, et al., describe a clinical case of an asymptomatic compound odontoma in the anterior left side of the maxilla associated with an impacted canine and a supernumerary tooth with a GC in a 47-year-old female with no relevant medical history.[16] CBCT was performed for precise three-dimensional localization of each structure and assessment of their spatial relationship with the associated structures before surgery. The treatment etiquette involved surgical enucleation of the odontoma, open extraction of both impacted and supernumerary teeth. The patient had uneventful healing and proceeded with the prosthodontic treatment plan.

150 CBCT pictures from patients sent to a maxillofacial radiology clinic in Babol, northern Iran, in 2021 were used in a cross-sectional study by Behrouzi E et al. (2024). The presence of the GC and the type of eruption (normal, delayed, and affected) were noted. If the GC was found, additional evaluation was done on its attachment point to the dental follicle (usual, atypical) and its opening site in the alveolar crest (buccal, lingual, and central). Out of the 150 CBCT pictures, 133 (88.7%) showed a GC. Moreover, impacted teeth were seen in 41 patients (27.3%). The GC was found in 92.1% (n=93), 75.0%.[2]

According to histology, GD is made up of a fibrous band that runs across the bony canal that joins the gingiva on top of the successional tooth's pericoronal follicular tissue. GD usually begins beneath the deciduous teeth on the alveolar bone crest.[1, 13]

Usually, no direct treatment is necessary for the gubernacular cord, a structure thought to direct tooth eruption. Its existence or lack, however, may be linked to major disruptions that call for action. Surgical techniques such as exposing the tooth or removing impediments may be required if a tooth is impacted or erupting abnormally. Alignment problems associated with aberrant eruption may also be resolved with orthodontic therapy. [4, 10]

4. Conclusion

By accurately observing the canal's shape, diameter, angulation, and localization using CBCT, it may be possible to predict the development of odontogenic tumours and identify abnormalities in the eruptive process, allowing for early intervention when needed. However, few dental professionals have given this structure any thought, and there aren't many scientific studies that have highlighted its significance.

5. Source of Funding

None.

6. Conflict of Interest

None.

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Cite this article: VishnuRao1 SG, Bankoti P. Gubernaculum dentis – A case report of an additional finding in cone beam tomography. *IP Int J Maxillofac Imaging*. 2025;11(2):61–65.