



CASE REPORT

Case Report: Unusual association of gubernacular canal, supernumerary tooth and odontoma with an impacted canine on cone beam computed tomography [version 1; peer review: 1 approved, 2 approved with reservations]

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Abstract

This report describes a clinical case of asymptomatic compound odontoma in the anterior left side of the maxilla associated with an impacted canine and supernumerary tooth with a gubernacular canal of a 47-year-old female with no relevant medical history. Cone-beam computed tomography (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 protocol involved surgical enucleation of the odontoma and open extraction of both impacted and supernumerary teeth. Patient had uneventful healing and proceeded with the prosthodontic treatment plan.

An experienced clinician can accurately diagnose a compound odontoma, as it has distinctive clinical and radiographic features. Thus, early detection and management of odontomas can help correction of any dental irregularity and avoid further complications.

Keywords

Gubernacular canal, Compound Odontoma, Supernumerary teeth, Cone Beam CT, Impacted Canine

Open Peer Review

Approval Status

	1	2	3
version 2 (revision) 26 Feb 2021		 view	 view
version 1 06 Oct 2020	 view	 view	 view

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Any reports and responses or comments on the article can be found at the end of the article.

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Author roles: **Elsayed LK:** Conceptualization, Investigation, Methodology, Project Administration, Resources, Supervision, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **El Khateeb SM:** Resources, Writing – Original Draft Preparation, Writing – Review & Editing; **Alzahrani SA:** Visualization; **ALHarthi SS:** Visualization, Writing – Review & Editing; **Ba-Hattab R:** Writing – Review & Editing

Competing interests: No competing interests were disclosed.

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Introduction

Odontoma is defined as a benign odontogenic tumor containing enamel, dentin and cementum, and are classified by the World Health Organization into two main types: compound and mixed^{1,2}. Compound odontoma consists of a tumorlike malformation (hamartoma) with varying numbers of tooth-like elements (odontoids). The complex odontoma consists of a tumour-like malformation (hamartoma) in which the enamel and dentin, and sometimes cementum, are present³. Pathogenesis of odontoma is still unclear, although some etiologic factors have been suggested such as trauma during primary dentition, genetic factors, and chronic inflammation⁴. They are usually small, asymptomatic and discovered through radiographic examination when patients present with a missing permanent tooth^{5,6}.

Odontomas may cause disturbances in the eruption of teeth such as impaction, delayed eruption, or retention of deciduous or permanent teeth, despite these critical disturbances only a few patients have been described⁷.

An impacted tooth is one that fails to fully erupt into the dental arch within the usual range of expected time. The tooth becomes impacted because abnormal tooth orientation, adjacent teeth, dense overlying bone, excessive soft tissue, or a genetic abnormality prevents eruption⁸. Exceptionally, it can be associated with the supernumerary teeth or an odontoma¹.

The gubernacular cord is a structure composed of conjunctive tissue that connects the tooth follicle to the overlying gingiva,

this cord guides or directs the course of the tooth eruption. A canal is formed within the bone by the osteoblastic activity to contain the gubernacular cord which is named gubernacular canal⁹⁻¹¹.

We present a case of an impacted upper canine with compound odontoma and a supernumerary tooth accompanied by gubernacular canal, where we utilised cone-beam computed tomography (CBCT) to diagnose the tumor prior to surgical treatment.

Case report

A 47-year old house wife – of African origin - presented to the dental clinic to treat multiple carious teeth, and to replace multiple missing teeth. On Intraoral clinical examination, both the maxillary canines were missing as well as the third molars, and there was a bulge on the buccal cortex of the missing maxillary left canine, which was asymptomatic (Figure 1a). The patient's medical history showed no previous incidence of dental/maxillofacial trauma or infections. She was referred to the Oral and Maxillofacial Surgery clinic for management. Panoramic radiograph revealed the presence of an impacted maxillary left canine and two small radiopaque masses distal to the impacted canine (Figure 1b) and the periapical radiograph showed that the apical mass is a supernumerary tooth and the coronal mass is a rounded denticle like mass (Figure 1c).

CBCT showed that tooth #23 was palatally impacted between teeth #21 and #22. There was a very small well defined rounded denticle like mass positioned distal to tooth #22 and coronal

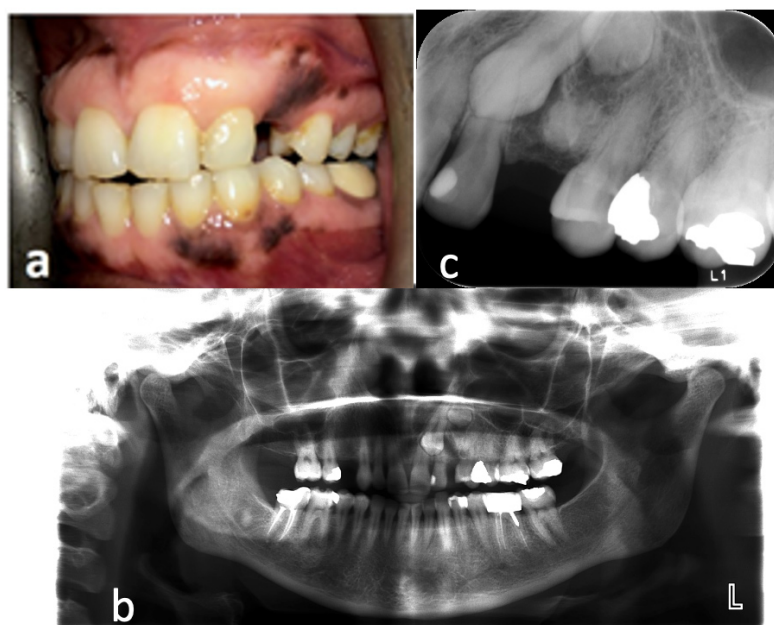


Figure 1. a) preoperative clinical intraoral photo showing buccal bulging opposite to the area of impacted left maxillary canine. b) preoperative panoramic radiograph showing impacted left maxillary canines and two radiopaque masses distal to it. c) preoperative periapical radiograph showing impacted canine, supernumerary tooth and radiopaque mass.

to the impacted supernumerary tooth (crown only), causing a small clinical buccal bulging and preventing its eruption. (Figure 2a, b, c).

The sagittal CBCT slice showed radiographic evidence of continuity of the follicular space of the supernumerary tooth along the bone up to its most inferior part at the alveolar ridge. This was determined to most likely be the gubernacular canal as it followed its possible eruption pathway through the bone. However, the denticle like structure was located inside this pathway and prevented the eruption of the supernumerary tooth. (Figure 2d)

The most probable differential diagnosis would be a compound odontoma because of its denticle like density, organization, and coronal position.

Intraoral surgery was planned under local anaesthesia, based on the clinical, radiographic findings and multidisciplinary consultation diagnosis of the radiopaque mass as a compound odontoma.

Local infiltration of the area was performed, a full-thickness mucoperiosteal buccal flap was raised to expose both the mass and supernumerary tooth and soft tissue in between, a palatal flap was raised to expose the impacted canine. The cortical bone was removed utilizing rotary instruments accompanied by normal saline irrigation to minimize heat generation. The calcified mass was identified and ditched all around and then elevated with a Coupland elevator. The incompletely formed supernumerary tooth along with soft tissue attached to it was extracted using straight forceps, and for identification, the soft

tissue was tagged with a black silk suture. By access from the palatal region, the impacted canine was sectioned horizontally and extracted (Figure 3 a, b, c), then the whole area was irrigated using normal saline and the flap was stitched back to its original position. A pre-surgical fabricated acrylic stent was placed to prevent falling of the palatal flap and to promote healing. Post-operative analgesia was prescribed in the form of acetaminophen 500mg every 6 hours. Clinical examination was performed 3 months post-surgical; patient was symptoms free and had uneventful recovery.

Macroscopically, the calcified mass measured $0.7 \times 0.5 \times 0.3$ cm (Figure 3 d), while the soft tissue mass measured $1.9 \times 0.4 \times 0.3$ cm (Figure 3e). Both specimens were placed in 10% buffered formalin for histopathological/histological examination and final diagnosis.

Histopathologic examination of the excised mass showed a tooth-like structure with dentin, dentinoid tissue, and some enamel matrix confirming the diagnosis of compound odontoma (Figure 4 a,b). Histological examination for the soft tissue mass showed epithelial lamina surrounded by collagenous connective tissue which confirms the diagnosis of gubernacular tissue (Figure 4 c).

Discussion

Odontoma is a benign tumour that is usually asymptomatic, diagnosed clinically through routine radiographic examinations, or when investigating other events such as the delayed eruption of permanent teeth, or ectopic position of teeth¹²⁻¹⁴, as is the case in our findings.

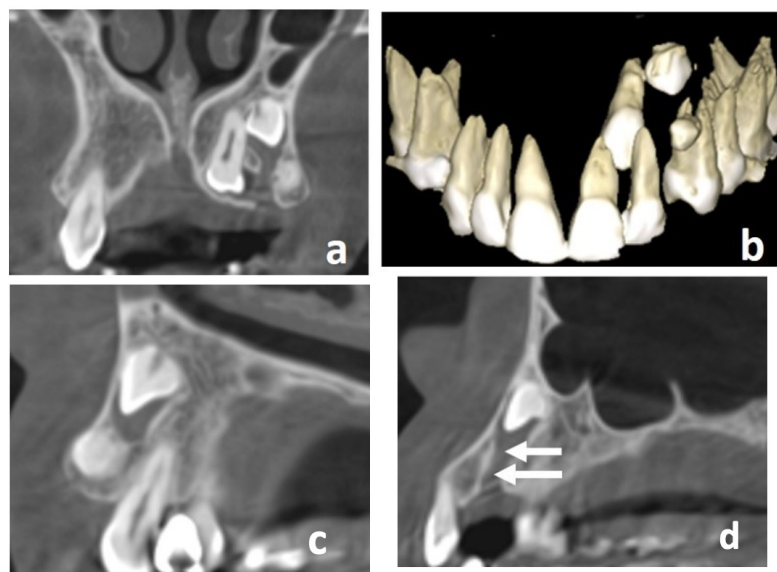


Figure 2. **a)** Coronal cone-beam computed tomography (CBCT) scan showing impacted left maxillary canine, supernumerary tooth and odontoma with continuous follicular space **b)** Three-dimensional CBCT reconstruction showing palatal impacted maxillary left canine together with supernumerary tooth and odontoma **c)** Sagittal CBCT scan showing odontoma occlusal to supernumerary tooth **d)** Sagittal CBCT scan showing the proposed gubernacular canal (white arrow).

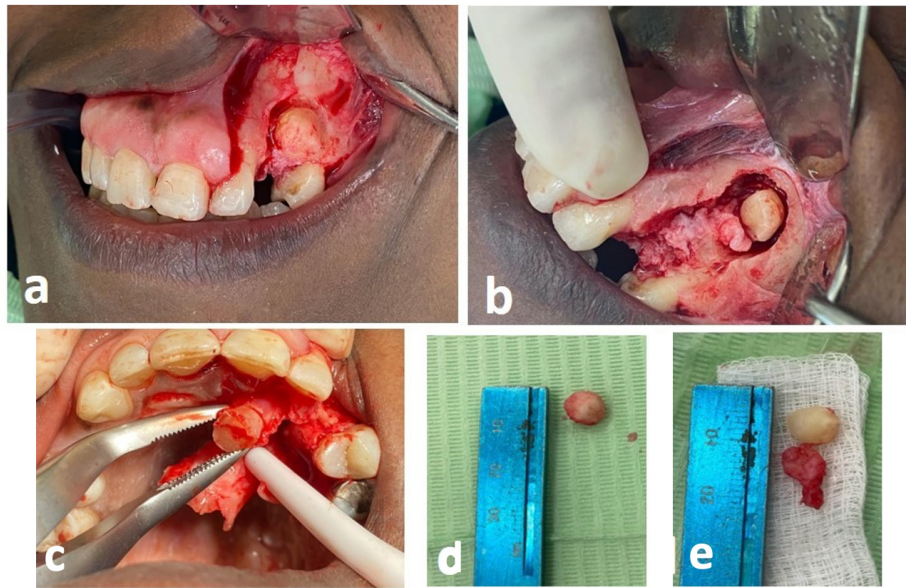


Figure 3. Intra-operative clinical picture showing surgical procedures to extract impacted maxillary left canine, supernumerary and odontoma **a)** Labial approach to expose the odontoma. **b)** Exposing the supernumerary tooth **c)** Palatal approach to extract the impacted maxillary left canine **d&e)** Measuring size of odontoma, supernumerary tooth and follicular tissue.

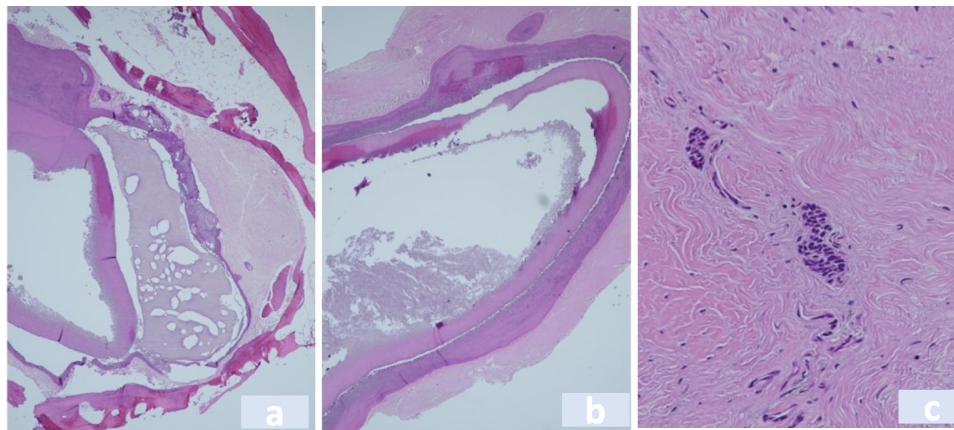


Figure 4. Histopathologic picture showing **a&b)** tooth-like structure with dentin, dentinoid tissue and some enamel matrix. **c)** epithelial lamina surrounded by collagenous connective tissue.

Odontomas are mostly located at the anterior maxilla and associated primarily with permanent teeth, although they can also be associated with deciduous teeth¹⁵⁻¹⁸. Due to its rare recurrence, conservative surgical excision is the treatment of choice for odontomas^{8,19}

Supernumerary teeth occur most frequently at the anterior midline, causing malposition of neighboring teeth or preventing their eruption^{1,6,20}. In the present case, the supernumerary tooth

was incompletely formed, and it was extracted along with the impacted canine and odontoma.

Panoramic and periapical radiographs are conventional two-dimensional radiographic techniques which are widely available and are frequently used for multiple diagnostic purposes like detection of impaction, odontoma, bone loss and various intraosseous lesions. Nevertheless, these radiographs have various limitations in revealing the buccolingual relationship,

and presence of superimposition, also having geometric inaccuracy²¹. In the current case, we primarily detect the presence of impaction of a supernumerary tooth and odontoma through panoramic and periapical radiograph.

CBCT is an advanced 3D imaging modality that offers precise localization and detection of the spatial relationships of any dental structure with the surroundings, also it lessens the radiation dose in comparison with conventional CT and delivers high spatial resolution²². In our case, we used CBCT for 3D localization of the odontoma, impacted canine and supernumerary tooth before surgical removal^{22,23}.

The role of gubernacular cord (GC) and the canal in tooth eruption is not clear, although it has been suggested that it may have a central role in inducing normal tooth eruption as it constitutes a pathway from the dental follicle to the gingiva for the eruption of permanent teeth¹¹. Oda M. *et al.*²⁴ suggested that the presence of and contact with the gubernacular tract (GT) should be added as a characteristic CT finding of some types odontogenic masses including dentigerous cysts, calcifying odontogenic cysts (Gorlin Cyst), odontomas, Adenomatoid Odontogenic Tumor and perhaps others. Moreover, they concluded that dentists should pay more attention to the association between the GT and odontogenic masses^{24,25}. Our case demonstrated an association between the GT and the odontoma where the odontoma was inside the GT of the supernumerary tooth with the same spatial relationship in agreement with Oda M. *et al.*²⁴ which reports that the majority of odontoma cases (about 70%) detected with CBCT were inside the GT of the unerupted teeth (Figure 2d). Furthermore, during surgery, it was apparent that the GT was contiguous with the supernumerary

follicle, suggesting that the GT was guiding the eruption of the supernumerary tooth, but the development of the odontoma prevented its eruption. Gaeta-Araujo H *et al.* reported that the most communal attachment site of GC was to the occlusal side of the dental sac of the unerupted tooth (93.2%) and was classified as a usual attachment. These findings were in agreement with our case, where we also found the GT to be attached to the occlusal aspect of the dental sac of the supernumerary tooth²⁵.

Conclusion

The anterior maxilla is the most common site for the development of a compound odontoma, causing various disturbances in eruption and teeth position. Having distinctive clinical and radiographic features; an experienced clinician can accurately diagnose a compound odontoma. Thus, early detection and management of odontomas can help the correction of any dental irregularity and avoid further complications. The dentist should also be aware of the probability of a close relationship between the development of odontoma and presence of the gubernacular tract, which in future could be used as a radiographic diagnostic criterion of an odontoma.

Consent

Written informed consent for publication of their clinical details and clinical images was obtained from the patient.

Data availability

Underlying data

All data underlying the results are available as part of the article and no additional source data are required.

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[PubMed Abstract](#) | [Publisher Full Text](#)

Open Peer Review

Current Peer Review Status:   

Version 1

Reviewer Report 04 February 2021

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 **Ronell Bologna-Molina** 

¹ Molecular Pathology Area, School of Dentistry, Universidad de la República, Montevideo, Uruguay

² Universidad Juárez del Estado de Durango, Durango, Mexico

It is a clear, simple and interesting article, easily understood by the reader. The authors describe a rare case of an odontoma in the anterior left side of the maxilla associated with an impacted canine and supernumerary tooth with a governmental canal.

There are some points that could improve the quality of the article:

- a) The x-ray image is not clearly representative of a composite odontoma, it could also be a complex odontoma. Due to the aforementioned, I suggest that in the histopathological image 4a and 4b) the authors mark and mark each dental tissue that makes up the odontoma (dentin, enamel, cementum). In image 4c, the authors should put the following description: It is observed odontogenic epithelium arranged in islands and cords surrounded by mature connective tissue, suggesting the presence of epithelial lamina surrounded by collagenous. Please indicate the magnification of the image (for example 50X, 100X or 400X).
- b) The reviewer suggests (in the discussion section) to go deeper into the imaging of the gubernacular tract with CBCT and the presence of odontomas or odontogenic tumors, I suggest reading in this article: Chaudhry and Sobti (2020¹).
- c) I believe that the conclusion paragraph that says "The dentist should also be aware of the probability of a close relationship between the development of odontoma and the presence of the governmental tract, which in future could be used as a radiographic diagnostic criterion of an odontoma" is very ambitious. I suggest that the authors clearly explain why they believe that it could become a radiographic criterion for an odontoma and/or not for another odontogenic tumor that has the presence of mineralized tissue.

Minor points:

- In the case report section, the authors describe the patient in the following way: "A 47-year old house wife - of African origin -" I think that this data is not important for the clinical case, I suggest describing only; "A 47-year old female ...".

References

1. Chaudhry A, Sobti G: Imaging characteristics of Gubernacular Tract on CBCT- A pictorial review. *Oral Radiol.* 2020. [PubMed Abstract](#) | [Publisher Full Text](#)

Is the background of the case's history and progression described in sufficient detail?

Yes

Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?

Yes

Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?

Partly

Is the case presented with sufficient detail to be useful for other practitioners?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Oral Pathology, Histopathology, Oral Medicine

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 13 Feb 2021

Lubna Elsayed, Suez Canal University, Ismailia, Egypt

- **a)** *The x-ray image is not clearly representative of a composite odontoma, it could also be a complex odontoma. Due to the aforementioned, I suggest that in the histopathological image 4a and 4b) the authors mark and mark each dental tissue that makes up the odontoma (dentin, enamel, cementum). In image 4c, the authors should put the following description: It is observed odontogenic epithelium arranged in islands and cords surrounded by mature connective tissue, suggesting the presence of epithelial lamina surrounded by collagenous. Please indicate the magnification of the image (for example 50X, 100X or 400X).*
- **Response a:** thanks for your opinion, it was considered and added (changes were added to the newly submitted version of manuscript).
- **b)** *The reviewer suggests (in the discussion section) to go deeper into the imaging of the gubernacular tract with CBCT and the presence of odontomas or odontogenic tumors, I*

suggest reading in this article: Chaudhry and Sobti (2021).

- **Response b:** Thanks for your recommendation and the suggested paper was very valuable.
- **c)** *I believe that the conclusion paragraph that says "The dentist should also be aware of the probability of a close relationship between the development of odontoma and the presence of the gubernacular tract, which in future could be used as a radiographic diagnostic criterion of an odontoma" is very ambitious. I suggest that the authors clearly explain why they believe that it could become a radiographic criterion for an odontoma and/or not for another odontogenic tumor that has the presence of mineralized tissue.*
- **Response c:**
Thanks and a paragraph was added in the discussion to explain the role of GT in differentiating between odontogenic and non-odontogenic lesions based on previous studies.

Minor points:

- *In the case report section, the authors describe the patient in the following way: "A 47-year old housewife - of African origin -" I think that this data is not important for the clinical case, I suggest describing only; "A 47-year old female ...".*

Response for minor point:

The recommendation was considered and changes were made, although it was a request by the editor.

Competing Interests: No competing interests were disclosed.

Reviewer Report 02 February 2021

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Prashanth Panta

Department of Oral Medicine and Radiology, MNR Dental College and Hospital, Sangareddy, Telangana, India

Odontoma is a common clinical entity and is often spotted on dental radiographs taken to inspect missing permanent teeth. However, this report's merit lies in the CBCT demonstration of an odontoma within the 'gubernacular canal' (GC)-a finding less frequently spotted on radiographs. Although vital in tooth eruption, GC goes unnoticed in dental radiographs due to a lack of focus on this crucial anatomical landmark. As rightly suggested by few previous authors and the authors of this report, this typical association could aid the radiographic diagnosis of odontoma. Because odontomas are closely associated with GC, they cause delayed/failure of eruption of the underlying permanent tooth. Since many clinicians may still be unaware of some of these aspects,

more technical reports are necessary for this direction. The current report by Lubna K. Elsayed *et al.* fills this gap.

Here are a few recommendations which could improve the manuscript:

1. The 'A 47-year old housewife – of African origin presented' can be modified as 'A 47-year old female – of African origin presented'
2. Supernumerary tooth and odontoma are also associated with syndromes. If the patient is non-syndromic, the phrase, 'an otherwise healthy and non-syndromic patient.' can be added to the case history section. A brief discussion on the syndromes associated with odontomas and supernumerary teeth may be a valuable addition to this report.
3. In the conclusion section, the sentence "Thus, early detection and management of odontomas can help correct any dental irregularity and avoid further complications" has been included. When odontomas are asymptomatic entities and discovered incidentally during radiographic surveys taken for evaluation of missing permanent teeth, how is early detection achievable? Consider adding some info regarding the same and mention which are the further complications.
4. Since the report mainly circles around GC, the conclusion paragraph could straightaway focus on the GC-odontoma connection. Consider avoiding conventional odontoma literature in conclusion. The below paragraph seems to be fitting:

'The dentist should be aware of the probability of a close relationship between the development of odontoma and presence of the gubernacular tract, which could be used as a radiographic diagnostic criterion of an odontoma.'
5. The discussion section can also include a brief review of *odontoma-GC literature* and *appropriate differential diagnosis*.
6. To avoid hype, the word 'unusual' can be removed from the title. The title 'Association of the gubernacular canal, supernumerary tooth, and odontoma with an impacted canine on cone-beam computed tomography' seems fitting.

Is the background of the case's history and progression described in sufficient detail?

Yes

Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?

Yes

Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?

Yes

Is the case presented with sufficient detail to be useful for other practitioners?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Oral medicine and radiology.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 13 Feb 2021

Lubna Elsayed, Suez Canal University, Ismailia, Egypt

- **Recommendation 1:** *The 'A 47-year old housewife – of African origin presented' can be modified as 'A 47-year old female – of African origin presented'*

Answer: Thanks for the recommendation and the change is accepted, although it was a request of the editor to mention "occupation".

- **Recommendation 2:** *Supernumerary tooth and odontoma are also associated with syndromes. If the patient is non-syndromic, the phrase, 'an otherwise healthy and non-syndromic patient,' can be added to the case history section. A brief discussion on the syndromes associated with odontomas and supernumerary teeth may be a valuable addition to this report.*

Answer: Thanks for your opinion, it was considered.

- **Recommendation 3:** *In the conclusion section, the sentence "Thus, early detection and management of odontomas can help correct any dental irregularity and avoid further complications" have been included. When odontomas are asymptomatic entities and discovered incidentally during radiographic surveys taken for evaluation of missing permanent teeth, how is early detection achievable? Consider adding some info regarding the same and mention which are the further complications.*

Answer: Thanks for the suggestion and further complications were added to the discussion section

- **Recommendation 4:** *Since the report mainly circles around GC, the conclusion paragraph could straightaway focus on the GC-odontoma connection. Consider avoiding conventional odontoma literature in conclusion.*

Answer: Thanks for the valuable comment and the recommended phrase was added to the conclusion section.

- **Recommendation 5:** *The discussion section can also include a brief review of odontoma-GC literature and appropriate differential diagnosis.*

Answer: Thanks for the comment and the suggestion was considered and added to the discussion section.

- **Recommendation 6:** *To avoid hype, the word 'unusual' can be removed from the title. The title 'Association of the gubernacular canal, supernumerary tooth, and odontoma with an impacted canine on cone-beam computed tomography' seems fitting.*

Answer: Thanks for the suggestion and it was considered.

Competing Interests: No competing interests were disclosed.

Reviewer Report 17 November 2020

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Hatem W. Amer 

Oral and Maxillo-facial Pathology Department, Faculty of Dentistry, Cairo University, Cairo, Egypt

The introduction is well written. The methodology and approach to diagnosis was systematic and the discussion was fruitful. It would have been more fulfilling to provide more past literature about the case and to discuss how the gubernacular canal could affect differential diagnosis both radiographically and histologically. All in all I found it very interesting.

Is the background of the case's history and progression described in sufficient detail?

Yes

Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?

Yes

Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?

Yes

Is the case presented with sufficient detail to be useful for other practitioners?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Oral and maxillofacial pathology

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 13 Feb 2021

Lubna Elsayed, Suez Canal University, Ismailia, Egypt

Thank you for your valuable comments and we appreciate your recommendations, and they were considered, a brief description about how the gubernacular canal could affect differential diagnosis both radiographically and histologically was added to the discussion section.

Competing Interests: No competing interests were disclosed.

Author Response 23 Feb 2021

Lubna Elsayed, Suez Canal University, Ismailia, Egypt

Thank you for your valuable comments, and your recommendations were considered as we added more literature about similar cases and a discussion about how the gubernacular canal could affect differential diagnosis both radiographically and histologically was added in the discussion section.

Competing Interests: No competing interests were disclosed.

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