

## Original Article

**PREVALENCE OF GUBERNACULAR CANAL IN THE MIXED DENTITION AND IMPACTED TEETH USING CBCT****Dr. Karishma Upadhyay<sup>1</sup>, Dr. Ganiga Channaiah Shivakumar<sup>2</sup>, Dr. Preeti P Nair<sup>3</sup>, Dr. Rashmi Deshpande Sathe<sup>4</sup>, Dr. Annette M. Bhambal<sup>5</sup>, Dr. Aparna Raj<sup>6</sup>**

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**ABSTRACT**

**Background & Objective:** Gubernacular canal is unique structure of dental lamina seen in erupting teeth which can be clearly visualized only in 3D imaging modalities like CBCT. The aim of this study is to access the prevalence of gubernacular canal in mixed dentition and impacted teeth using CBCT according to their age and gender.

**Materials and methods:** A retrospective study of 147 patients with CBCT imaging was done which included 512 impacted / erupting teeth. The presence / absence of gubernacular canal was noted according to age, gender & erupting status of teeth.

**Results:** Out of total 147 patients, 77 were females & 70 were males (age group- 5 to 20 years), with presence of GB canal is 126 patients (85.7%), 96 (65.3%) teeth were located in mandible & 112(76.2%) were erupting whereas 35 (23.8%) were impacted.

**Conclusions:** According to the present study the prevalence of gubernacular canal was high (85.7%). Results were found to be non – significant on comparing the presence of GB canal with different variables of age, gender and impacted teeth with chi – square test.

**Keywords:** Cone beam computed tomography; Gubernacular canal; Impacted; Tooth eruption.

**Introduction**

Gubernacular cord is a structure formed from the epithelial cells of dental lamina uniting with the epithelium of reduced enamel organ. This structure is present above the occlusal portion of the dental follicle consisting of connective tissue, nerves, vessels & various lymphatic channels. <sup>(1)</sup> Gubernacular cord contains different chemical mediators like EgF4 which causes osteoclastic activity resulting in the formation of gubernacular canal, providing a pathway for erupting successor. <sup>(2)</sup> (figure.1)

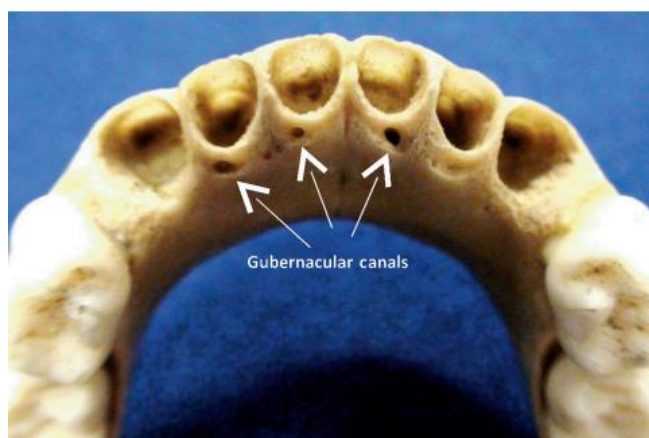


Figure 1. shows dry child skull. Gubernacular canals behind the mandibular deciduous incisor in the alveolar bone crest <sup>(7)</sup>

Gubernacular canal also known as gubernacular dentitis, is a delicate narrow pathway measuring approximately 1-3mm in diameter. <sup>(3)</sup> Due to its small diameter and intricate nature this structure is difficult to visualize in 2D imaging such as Ortho-pantomograph. As these imaging modalities have an inherent drawback of magnification & superimposition, CBCT is the apt visualization technique to foresee these structures. <sup>(4)</sup>

Evaluation of characteristics such as shape, diameter, angulation and localization of this canal, precisely observed by means of CBCT, may help to indicate abnormalities in the eruptive process, and to predict the development of odontogenic tumours, thereby making early intervention possible, whenever necessary. <sup>(5)</sup>

CBCT can aid in assessing shape diameter & location of GB canal thus identifying abnormalities in eruption process of permanent teeth. This knowledge can be helpful specially for the orthodontic assessment in mixed dentition period & predicting the formation of odontogenic tumours if any, so that timely intervention is possible. <sup>(6)</sup>

### Materials and Methods

Total number of 128 CBCT Scans were randomly selected scans out of which total number of 512 teeth were observed for presence of gubernacular canal in relation with age and gender, from the Department of Oral Medicine & Radiology's archive at People's University's CBCT centre were scanned in order to gather data for this study. The study includes pictures of teeth that were impacted or erupting. Dental malformations, edentulous patients, patients with picture artifacts, and patients with any pathology in the examination area were not included. <sup>(3)</sup> Patients with age group between 5 years till 20 years are selected in the study.

Carestream 9600 3D tomography device with 90- 120 kvp, 13–16 mA, 4 x 4, 5 x 5, 6 x 6, 10 x 8, 12 x 10 cm FOV parameters was used to obtain the image. The gubernacular canal was examined in multiplanar images reconstructed using Carestream software program (Figs. 2 and 3)

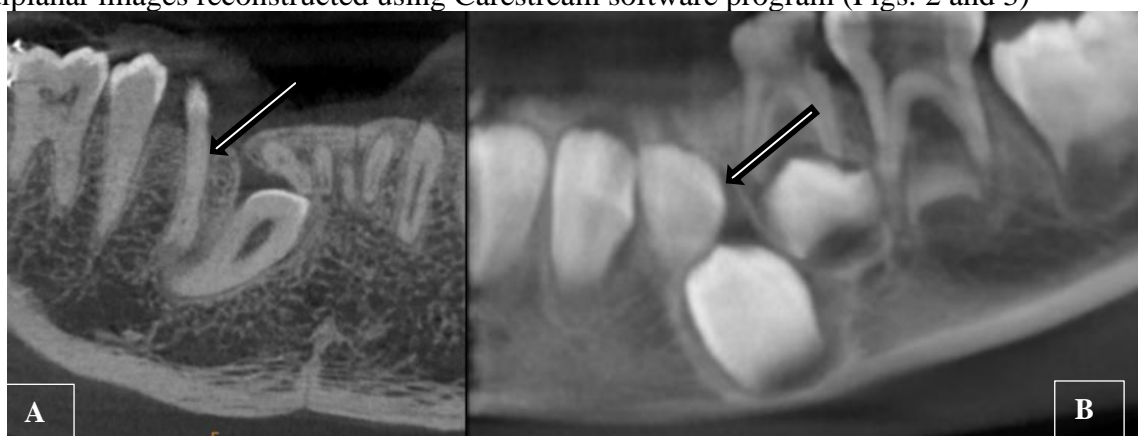


Fig.2 A. CBCT image of Sagittal sections (slice thickness 150  $\mu$ m) showing gubernacular canal (marked by

arrow) in lower right mandibular canine teeth

B. CBCT image of Sagittal sections (slice thickness 4 mm) showing gubernacular canal (marked by arrow) in lower left mandibular premolar teeth

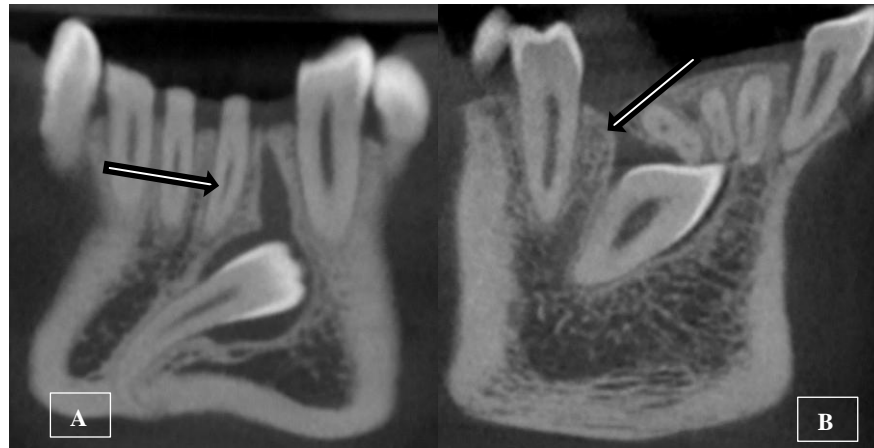


Fig.2 A. CBCT image of coronal sections (slice thickness 150  $\mu$ m) showing gubernacular canal (marked by arrow) in lower right mandibular lateral incisor teeth

B. CBCT image of coronal sections (slice thickness 150  $\mu$ m) showing gubernacular canal (marked by arrow) in lower right mandibular canine teeth

## Results

The prevalence of the gubernacular canal was notably high, with 85.7% of the sample (n=126) presenting with the canal, while it was absent in only 14.3% (n=21). This suggests a strong presence of the gubernacular canal in the examined population.

Regarding tooth eruption status, a majority of the teeth were erupting (76.2%, n=112), while 23.8% (n=35) were impacted. This indicates that most of the sample was in the process of normal tooth eruption, with a smaller proportion showing impaction, which could potentially affect the development and positioning of adjacent structures.

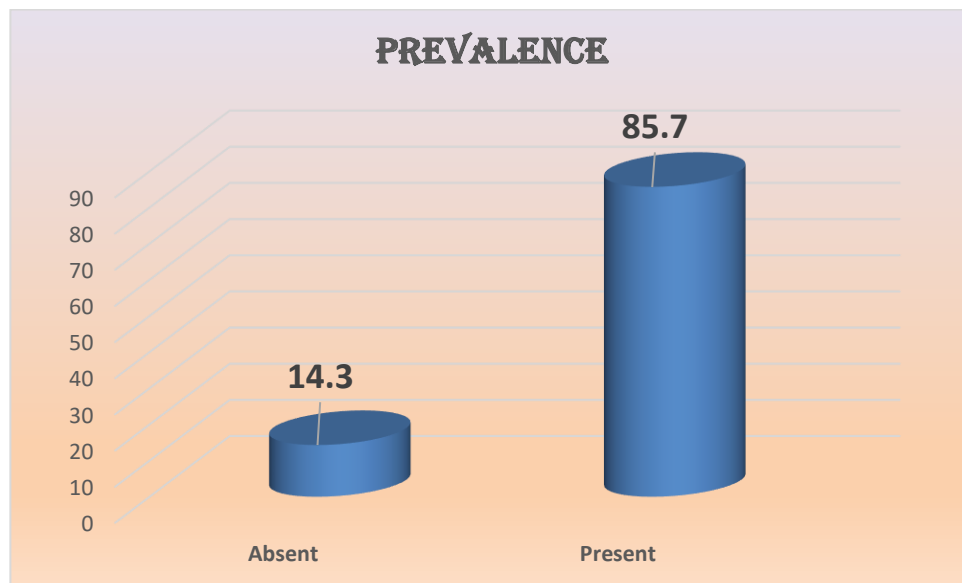
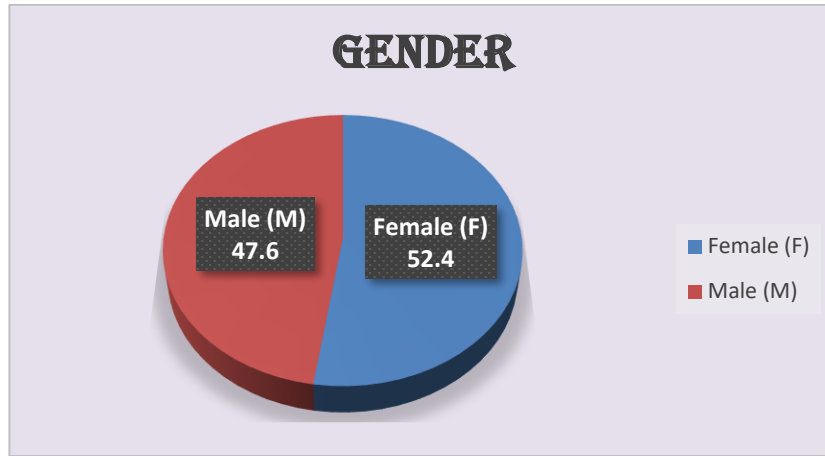
In terms of location, the mandible was the most common site, with 65.3% (n=96) of cases. The maxilla was involved in 22.4% (n=33) of cases, and both maxilla and mandible were affected in 12.2% (n=18). This distribution suggests that mandibular teeth are more frequently associated with gubernacular canal presence or observed changes in this population.

The data reflects a high prevalence of the gubernacular canal across both genders, predominantly associated with erupting mandibular teeth, highlighting important considerations for clinicians assessing mixed dentition and impacted teeth in similar populations.

**Table 1: Descriptive distribution of all variables in the study**

Category	Frequency	Percentage
<b>Gender</b>		
Female (F)	77	52.4
Male (M)	70	47.6
<b>Gubernacular Canal Prevalence</b>		
Absent	21	14.3
Present	126	85.7
<b>Tooth Status</b>		
Erupting	112	76.2
Impacted	35	23.8
<b>Location</b>		
Mandible	96	65.3
Maxilla/Mandible (Both)	18	12.2
Maxilla	33	22.4
<b>Total</b>	147	100.0

Table 1 provides an overview of the demographic and clinical characteristics of the sample population in a study examining the prevalence of the gubernacular canal in mixed dentition and impacted teeth using CBCT. The study included 147 individuals, with a nearly even distribution of gender, comprising 52.4% females (n=77) and 47.6% males (n=70).



**Table 2: Association of gubernacular canal with variables**

Variation	Chi-Square Statistic	P-Value	Significance
Gender vs Gubernacular Canal	0	1.00(NS)	Not Significant
Erupting/Impacted vs Gubernacular Canal	0.689	0.40(NS)	Not Significant
Location vs Gubernacular Canal	2.533	0.11 (NS)	Not Significant

NS =Not significant

The association between the gubernacular canal and various demographic and clinical variables was

analysed using the chi-square test. The relationship between gender and the presence of the gubernacular canal yielded a chi-square statistic of 0, with a p-value of 1, indicating no statistically significant association between these variables. Similarly, when comparing erupting versus impacted cases with the presence of the gubernacular canal, the chi-square statistic was 0.689, with a p-value of 0.40, suggesting no significant association in this aspect either (Table.2)

For the variable "location" (e.g., mandibular vs maxillary), the analysis showed a chi-square statistic of 2.533 with a p-value of 0.11. Although this p-value is closer to the threshold for statistical significance, it still does not reach the conventional level of significance ( $p < 0.05$ ). Therefore, we conclude that location does not have a statistically significant association with the presence of the gubernacular canal. However, this association, being on the cusp, might be worth exploring in a larger sample or with additional context, as descriptive trends could reveal subtle patterns in how location relates to the canal's occurrence.

## Discussion

Gubernacular Canal serves as a crucial guide for the permanent teeth's normal eruption. This canal shrinks as the eruptive process progresses and vanishes when the tooth reaches the alveolar crest. Consequently, the length of the glomerular canal would decrease with increasing distance between the dental follicle and the alveolar crest. <sup>(10)</sup> Because of the osteoclastic activity in the area, the Gubernacular Canal's diameter increases during the eruptive stage as the successor tooth approaches toward the oral mucosa. <sup>(7)</sup> This enlargement takes place in order to make room for the tooth's crown during eruption. The coronal follicle's epithelial component increases as the permanent tooth progresses toward the gingiva and incorporates islets and epithelial cords of the Gubernacular Cord. <sup>(7)</sup>

Since there may be deformation in unerupted teeth and a considerable angulation of this canal with respect to the tooth's long axis, the delay in tooth eruption may be directly linked to a Gubernacular Canal deficiency. <sup>(11)</sup>

By means of CBCT the Gubernacular Canal can be identified in the majority of patients with normal tooth eruption, during different periods of their growth and development. Characterized in the sagittal and coronal cuts as a low-density bone canal connected to the dental follicle of unerupted permanent teeth, the Gubernacular Canal may also be observed by means of the axial cut as a narrow, low density circular structure, with a diameter of approximately 1 to 3 mm, localized in the lingual region of the deciduous predecessors. <sup>(10,11)</sup> Evaluation using CBCT images is essential in some situations involving impacted and extra teeth. It is possible to see aberrant Gubernacular Canal tomographic features in these teeth, including distortion, obliteration, and fluctuations in their angulation <sup>(6)</sup>

Despite the first reference to the gubernacular cord and canal have been shown in 1778 by John Hunter, 234 years ago, the existence and function of this structure are still controversial and questioned. According to Hodson. <sup>(12)</sup> This reference was supported in 1887 by microscopic research by French histologist Louis Charles Malassez (Malassez, 1885). According to Hodson, these structures are present only in association with the permanent teeth with temporary predecessor, a truth confirmed by Cahill and Marks (1980), Hodson (1971) <sup>(13)</sup> and Philipsen and Reichart (2004). <sup>(14)</sup>

There are studies in the literature that use radiographic evaluation of Gubernacular tract in odontomas, supernumerary teeth, and impacted teeth (Ahmed et al., 2015; Nishida et al., 2015; Oda et al., 2016a; Koc et al., 2019). There aren't any research looking at Gubernacular tract only in supernumerary teeth, and these studies are scarce. <sup>(4)</sup> In this study prevalence of gubernacular canal is seen in impacted and erupting teeth and some of the supernumerary teeth which shows high prevalence in the erupting teeth i.e 76.2%.

In study, performed only on impacted teeth, found a GC detection rate of 53.2%. Gaêta-Araujo et al. <sup>(8)</sup> showed observed GC detection rates of 87.1%, 62.9%, and 94. Oda et al. reported a detection rate of 90% in teeth with normal eruption and a lower GC prevalence rate in the teeth with delayed eruption (central incisor: 81.1%, lateral incisor: 83.3%, canine: 50%). The detection rate of GC in mesiodens was reported to be significantly lower (23.4%). <sup>(11)</sup> In this study GC prevalence rate in

erupting teeth is high with 76.2% and lower in impacted teeth 23.8%.

For some authors the relationship of Gubernacular canal and Gubernacular cord with the eruptive process is evident and significant, since the guide teeth in the direction of the alveolar crest.<sup>(15)</sup>

Ugurlu et al. evaluated the existence and typical of the GC in CBCT images of 231 patients with a mean age of  $28.0 \pm 0.90$  years according to gender, age. While 31% (N:146) of the 471 teeth examined had canals, 69% (N:325) did not have canals.<sup>(16)</sup> These values are different from our study; the lower incidence of the GC in this study can be explained by the higher mean age of the patients included, because the presence of GC decreases with age.

Gubernacular canal was observed in 133 (88.7%) of the total 150 CBCT images. Also, 41 cases (27.3%) had impacted teeth. The detection rate of the gubernacular canal in the normal, delayed, and impacted eruption of teeth was 92.1% (n=93), 75.0% (n=6), and 82.9% (n=34), respectively (p=0.135). Opening the gubernacular canal in the alveolar crest was not associated with teeth eruption status. Also, unusual attachment sites of the gubernacular canal to dental follicles were mostly seen in abnormal eruptions.<sup>(17)</sup> In our study the values are different and opening of the gubernacular canal in the alveolar crest and its presence shows its association with the eruption status of the impacted or erupted tooth.

The study's limitations include the inability to assess pathological conditions that hindered tooth eruption, the retrospective nature of the study, the inability to gather information about the patients' systemic diseases, and the difficulty in detecting the presence of the canal due to the inclusion of the third molar tooth in the study in an abnormal position. It was not possible to gather information on the clinical prognosis of impacted or erupting teeth whose eruption could not be monitored. It is advised that future research classify the canal orientation and assess the gubernacular canal in a wider sample and across various jaws, including tooth groups.

## Conclusion

The prevalence of the gubernacular canal plays a significant role in the eruption status of teeth, particularly in differentiating between erupting and impacted teeth. The presence of this canal facilitates the eruption pathway by guiding the tooth through bone resorption and soft tissue remodelling. Its absence or narrowing may contribute to impaction, necessitating clinical intervention. Understanding its prevalence and characteristics through imaging aids in diagnosing eruption disturbances, planning surgical interventions, and improving patient outcomes. Further research is essential to explore its role in various populations and refine diagnostic criteria for better clinical decision-making in dental practice.

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