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ORIGINAL PAPER

# A Study on Dentigerous Cystic Changes with Radiographically Normal Impacted Mandibular Third Molars

**Greeshma G. Wali · V. Sridhar · H. N. Shyla**

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**Abstract**
*Background* Dentigerous cyst develops in the follicular tissue surrounding the impacted lower third molar. A study was carried out to know the incidence of Association of Dentigerous cyst with radiographically normal impacted lower third molars and to draw the attention of the Oral Surgeons towards the prophylactic removal of impacted third molars.
*Methods* A prospective study was done on 30 patients with impacted lower third molars which were indicated for extraction. The follicle tissue surrounding the impacted tooth was subjected for histopathologic investigations. Only those teeth with a radiographic finding of pericoronal space of less than 2.5 mm were considered. Two Oral Pathologists reviewed the slides for any changes suggestive of cystic pathology.
*Results* Pathologic changes suggestive of Dentigerous cyst was found in 7 of the 30 follicular tissue sent for histopathologic testing. It was found to be statistically significant ($P < 0.001$).
*Conclusion* This study shows statistically high incidence of Dentigerous cyst association with radiographically normal impacted lower third molar teeth. Hence the Oral and Maxillofacial surgeons should consider histopathologic evaluation and radiographic diagnosis in the management of impacted lower third molars. Prophylactic extractions of normal impacted lower third molars should be considered as a treatment option.

**Keywords** Impacted lower third molars · Prophylactic extraction · Dentigerous cyst

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## Introduction

An impacted tooth is one of the most common complaints a patient presents with to the Oral and Maxillofacial Surgeon for treatment. These are developmental pathologies characteristics of a modern civilization. Any tooth in the oral cavity can be impacted, but the most commonly affected tooth is the lower third molar. Transition from eating coarse to refined food, timely management of any dental pathology has lead to insufficient space behind the second molars for the third molars to erupt. Skeletal deficiency due to the process of evolution, lack of co ordination between maturation of the permanent dentition and exfoliation of the primary dentition, genetic inheritance are few of the other reasons explaining the susceptibility of the lower third molars to be impacted [1].

The process of odontogenesis occurs mainly inside a fibrous sac known as a dental sac or follicle. It is also called as a developmental sac since it plays a very important role in the development and the eruptive process of a tooth. The follicle is made up of ectomesenchymal cells and fibers and remains adjacent to the crown of the unerupted or impacted tooth [2].This follicle is seen as, a more or less uniform radiolucent area with a sclerotic border around the crown of the tooth on radiographs [3]. According to Gorlin [4] during the histological process of tooth development, the odontogenic tissue around the tooth has the propensity to

differentiate into a wide variety of pathological tissue. Thus the development of cysts or tumors in the region of an impacted tooth is not unexpected.

Dentigerous cysts (DC) are the most common of the developmental odontogenic cysts of the jaws and account for 24% of them [5]. They are defined as true developmental pathologies of the jaws and so are most commonly associated with impacted teeth, particularly the permanent mandibular third molars, maxillary canines and to some extent the mandibular premolars and the maxillary third molars [6]. These cysts are usually asymptomatic and are diagnosed on routine radiographic examination or in the later stages when the cyst size has increased considerably. Despite the importance of radiographs in diagnosing dentigerous cysts, Muller and Bear [7] stated that minor histological cystic changes may be present in the follicle tissue which is not depicted on the radiographs. It can also be the other way round where in there is enlargement of the pericoronal space but histological examination does not reveal any pathology. Hence biopsy of the pericoronal follicular tissue is imperative in every case. According to Farah and Savage [8] a pericoronal space of 2.5 mm on an intra oral radiograph and greater than 3 mm on a rotational panoramic radiograph should be investigated thoroughly. In a histological study on 170 impacted teeth follicles, Knight et al. [9] found that 44.7% of them had histological features of DC with no radiographic evidence of enlargement of the follicle space. In a study conducted by Aldesperger [10] on 100 impacted third molars with pericoronal space less than 2 mm, 34% of the follicles had histological changes resembling DC. Thus both the above mentioned studies show that prevalence of pathological condition is generally higher than that assumed from radiographic examination of the tissue alone.

One of controversial topics debated over years and observed keenly by one and all is the advisability of prophylactic removal of impacted third molars. There has been evidence based reasoning by surgeons for and against the prophylactic extraction of ILTM, as a result of which the topic yet remains controversial and confusing [11].

Proponents of routine surgical extraction of ILTM believe that early extraction is preferable, as it defers the margin of doubt regarding the possibility of associated pathology later in life. Other surgeons who do not advocate the routine removal of impacted lower third molars feel that the possibility of developing a pathology later in life does not justify the physical and psychological trauma a patient undergoes during the procedure. But if the decision is not to routinely extract the impacted lower third molars; there is a possibility of an even more traumatic surgical procedure if pathology arises with the impacted lower third molar [12]. Presence of cystic changes on radiographically normal ILTM supports routine surgical extraction of the impacted tooth.

This study was conducted to investigate the presence of any pathology resembling DC associated with radiographically normal follicle surrounding the ILTM.

### Objectives

To investigate the incidence of cystic changes specifically related to the DC in radiographically normal ILTM.

## Materials and Methods

A prospective study was conducted to know the incidence of DC in the follicle around the ILTM with no radiographic or clinical evidence of cystic changes. The study comprised of 30 patients with impacted lower third molars which were indicated for extraction for various reasons. 40 impacted lower third molars were extracted, but 10 of the follicle tissues were not examined because of insufficient tissue. These patients did not have any clinical or radiographic evidence of cystic pathology. The follicle tissue surrounding the crown of these ILTM was subjected for histopathological examination. Approval from the ethical committee was obtained before proceeding with the study.

Inclusion criteria:

1. Impacted lower third molars indicated for extraction.
2. Impacted lower third molars with a follicular space of less than 2.5 mm.
3. Impacted lower third molars with two roots, fused roots or conical roots in which the long axis of the tooth can be appropriately determined will be considered.
4. Age group-18–30 years.

Exclusion criteria:

1. Impacted lower third molars with dilacerated, curved roots, where in the long axis of the teeth cannot be determined.
2. Patients with any systemic disorder.

### Radiographic Evaluation

Orthopantomograph of all the subjects were taken using Panoramic X-ray machine. Patients chin and occlusal plane was positioned properly with the mid sagittal plane centered within the focal trough of the X-ray unit. Standard exposure time was used. Orthopantamograph with minimum distortions were considered.

The contours of the ILTM, pericoronal radiolucency, the surrounding bone and teeth were traced on the tracing

paper on the X ray viewer. The method used to measure the widest point of the follicular space was in accordance with the method used by Damante and Fleury [13]. Two perpendicular lines (AA′ and BB′) were drawn on the image of the impacted teeth. One line passing through the long axis of the tooth and other line passing through the centre of the crown. Starting from the intersection of the two lines, a ruler was moved to the widest area of the follicular space where measurements were done with a caliper ruler (Fig. 1). After meeting the inclusion and exclusion criteria an informed consent of the patient was taken for surgical removal of impacted lower third molars.

Surgical Procedure

The transalveolar extraction of all the 30 ILTM's was carried out under local anesthesia by the same surgeon. A mucoperiosteal flap was elevated after a Wards incision to expose the underlying tooth. If any coronal follicle tissue was found, it was carefully dissected out using blunt forceps and preserved. The bone surrounding the impacted teeth that is, on the buccal and the distal aspect was guttered with bur under copious saline irrigation. Few cases required sectioning of the teeth which was also done using a bur under copious saline irrigation. The tooth was gently elevated from the socket taking care not to damage the follicular tissue. After the tooth was removed, the follicle was enucleated from the socket attachment and then washed with water. The surgical site was irrigated and closed with 3–0 silk sutures.

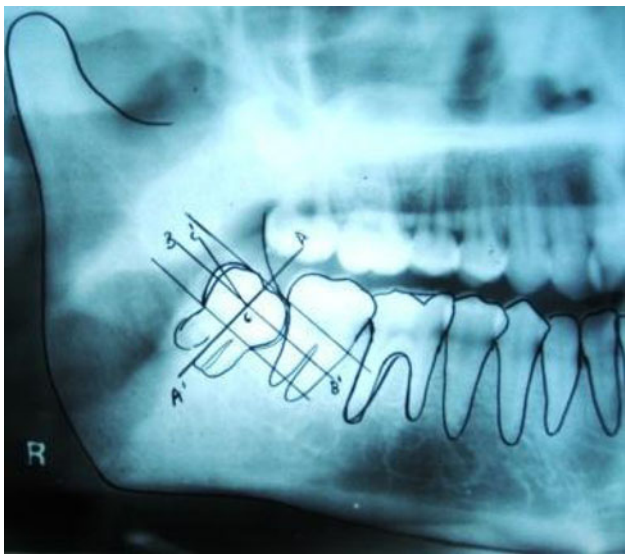


**Fig. 1** Follicular space measurement

Histopathologic Technique

The excisional biopsy specimens were obtained after transalveolar extraction of the ILTMS's. They were washed in water and immediately fixed in 10% neutral formalin solution and processed 0.5 μm thick sections of the specimen were obtained from the paraffin embedded blocks using a rotary microtome. The sections were then stained using Hemetoxylin and Eosin. Two Oral Pathologists who were involved in the routine diagnostic histopathologic investigations reviewed the slides. To reduce the interobserver discrepancy same set of slides were given to both the Oral Pathologists.

The findings observed by the Oral Pathologists were:

- Non keratinizing stratified squamous epithelium
- Reduced enamel epithelium
- Fragmented epithelium
- Absence of epithelium
- Underlying connective tissue with Odontoid Island

## Results

Of the 30 follicle tissues studied, 18 were from male patients and 12 were from female patients. The age group of the patients studied is 18–30 years. The follicle space measured on the radiographs was 1 mm in 21 patients, 1.50 and 2.0 mm in 6 and 3 patients, respectively.

Histological features examined for were the presence of epithelial lining, either reduced enamel epithelium, stratified squamous epithelium and connective tissue with odontoid islands. Histological changes taken into consideration were, the presence of stratified squamous epithelium which was suggestive of Dentigerous cyst (Fig. 2). 7 of the 30 patients had these findings in the follicle. Of the 7 patients, 1 patient was in the age group of 18–20 years and 6 were in the age group of 21–25 years (Table 1, Fig. 3). 5 male and 2 female patients had follicular tissue suggestive of DC on histopathological examination (Table 2, Fig. 4). The highest incidence (6 patients) of DC was seen in the follicular space measuring 1 mm followed by 1 patient with a follicular space measuring 2 mm (Table 3, Fig. 5).

Thus 7(23%) of the 30 patients with radiographically normal ILTM's had cystic changes similar to DC which is statistically significant (Table 4, Fig. 6).

1. Z-test for a proportion (Binomial distribution) was used for this study.
   *Objective* To investigate the significance of the difference between the assumed proportion and the P0 and the observed proportion P

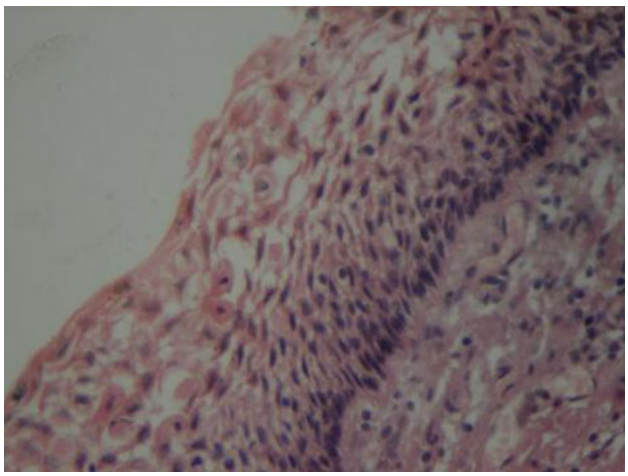

**Fig. 2** Histologic findings-stratified squamous epithelium lining the follicle tissue of the impacted lower third molars:suggestive of dentigerous cyst

**Table 1** Incidence of dentigerous cyst according to age

| Age in years | Number of patients | Dentigerous cyst | | *P* value |
|---|---|---|---|---|
| | | No | % | |
| 18–20 | 5 | 1 | 20.0 | 0.861 |
| 21–25 | 17 | 6 | 35.3 | 0.242 |
| 26–30 | 8 | 0 | 0.0 | – |
| Total | 30 | 7 | 23.3 | – |

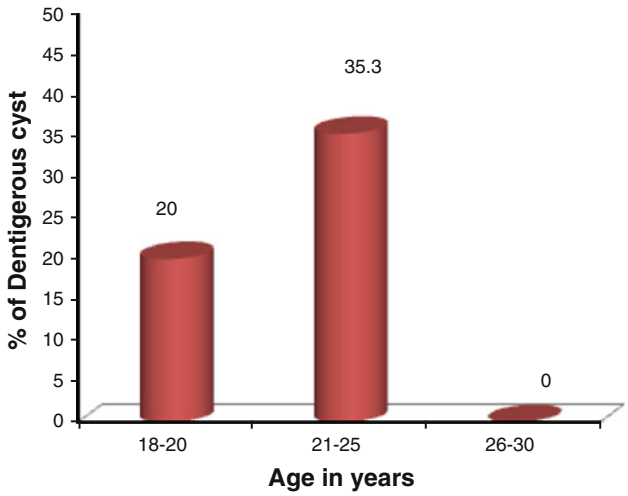


**Fig. 3** Incidence of dentigerous cyst according to age

**Table 2** Incidence of dentigerous cyst according to gender

| Gender | Number of patients | Dentigerous cyst | | *P* value |
|---|---|---|---|---|
| | | No | % | |
| Male | 18 | 5 | 27.8 | 0.652 |
| Female | 12 | 2 | 16.7 | 0.589 |
| Total | 30 | 7 | 23.3 | – |

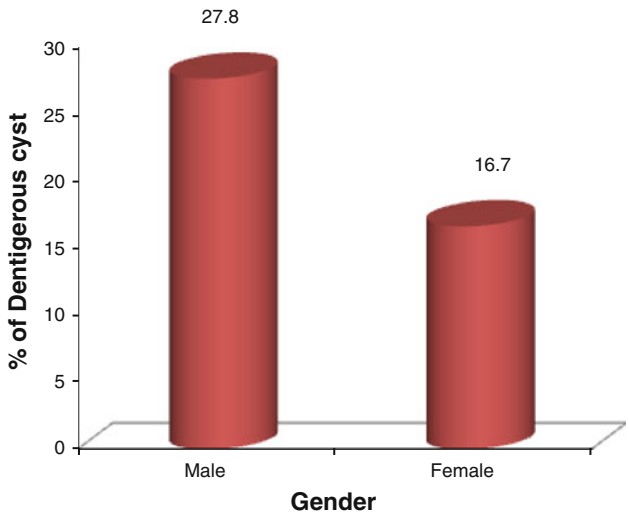


**Fig. 4** Incidence of dentigerous cyst according to gender

**Table 3** Incidence of dentigerous cyst according to follicular space

| Follicular space | Number of patients | Dentigerous cyst | | *P* value |
|---|---|---|---|---|
| | | No | % | |
| 1.0 | 21 | 6 | 28.6 | 0.565 |
| 1.50 | 6 | – | – | – |
| 2.0 | 3 | 1 | 33.3 | 0.682 |
| Total | 30 | 7 | 23.3 | – |

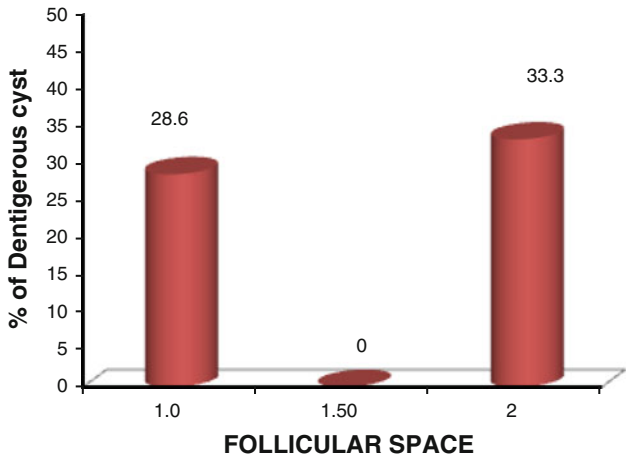


**Fig. 5** Incidence of dentigerous cyst according to follicular space

**Table 4** Definitive diagnosis

| Definitive diagnosis | Number ($n = 30$) | % | 90%CI |
|---|---|---|---|
| Dentigerous cyst ($P$ value $< 0.001$) | 7 | 23.3 | 13.2–37.9 |
| Normal follicular tissue | 23 | 76.7 | 62.1–86.2 |

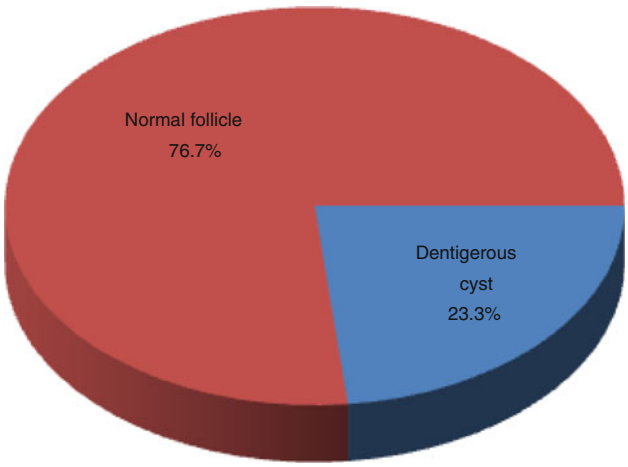


**Fig. 6** Definitive diagnosis

$$Z = \frac{(!p - p_0!) - 1/2n}{\sqrt{p_0 q_0 / n}}$$

2. 90% Confidence interval
   $P \pm 1.64$ * SE(P), where SE(P) is the standard error of proportion = P*Q/$\sqrt{}$n.
3. Significant figures

   \+ Suggestive significance $0.05 < P < 0.10$
   * Moderately significant $0.01 < P \leq 0.05$
   ** Strongly significant $P \leq 0.01$

Statistical software

The Statistical software namely SPSS 15.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc**.**

## Discussion

The incidence of impacted or embedded teeth accounts for between 14 and 96% of the population. Among this 98% of the impacted teeth are the third molars of which only 50% of the lower third molars erupt into the oral cavity [1]. According to Robert et al. [14], the third molar is the last tooth to develop and its presence is noticed on the radiographs at the age of 9 years. During the initial phase of its development, the tooth is located near the anterior border of the ramus with the occlusal surface facing anteriorly and at the level of the erupted dentition. Crown and root formation with an open apex is completed by the age of 14 and 18 years, respectively. The eruption of the lower third molars depends on the development of the ramus, angle and body of the mandible with changes in the axial inclination occurring around 16–18 years. By the age of 24 years, 95% of them erupt into the oral cavity. Ledyard [15] studied 375 lateral roetgenograms of right and left jaws of orthodontic patients. Measurements were made on the tracings from the distal aspect of the lower first molar on the occlusal plane to the anterior and posterior aspect of the ramus. These curves leveled off at about the age of 14 years and there was little growth after that. He concluded that there is little growth after 15–16 years and a study of the tooth and bone structure at this time would determine if sufficient space is available for the third molar to erupt. According to Bjork [16], if there is lack of space prior to the eruptive phase of the lower third molars, its long axis will get abnormally inclined. This increases the chances of its movement getting arrested by the crown or root of the second molars.

Dental follicle is the fibrous remnant of the odontogenic process and responsible for the formation of periodontal ligament and the cementum [17]. This fibrous layer is lined inside by reduced enamel epithelium with a propensity for squamous metaplasia as age increases [18].

If the lower third molar is overdue for eruption, then according to Cansolaro [19] the reduced enamel epithelium and remnants of the dental follicle in the connective tissue have the potential for cystic or neoplastic transformation. The above statement is supported by Glosser and Campbell [20] and Curran, according to them any follicle with squamous epithelium should be regarded as Dentigerous cyst.

The DC develops around the crown of the unerupted teeth by expansion of the follicle when the fluid collects or a space occurs between the reduced enamel epithelium and the enamel of the impacted teeth. These cysts are usually asymptomatic and are diagnosed on routine normal radiographic examination or following acute inflammatory episode. Swelling, pain, tooth displacement mobility and sensitivity may be present if the cyst reaches the size larger than 2 cm. Radiograph of the DC usually shows a well defined unilocular radiolucency with a sclerotic border surrounding the crown of the impacted teeth [22].

The present study was conducted to identify early cystic changes associated with the radiographically normal dental follicle of asymptomatic ILTM's. The study group consists of 30 subjects with their ILTM's indicated for extraction. 30 follicular tissues were obtained with a maximum follicular space of 2.5 mm. Among these subjects, 18 male and 12 female subjects had impacted lower third molars in the ratio of 1.5:1. The incidence of DC in males (27.8%) and females (16.7%) was in the ratio of 1.6:1 which is favorably similar to the finding by John [10], Regezi and Sciubba [23] which was 1.5:1 and 1.6:1, respectively. The subjects based on gender were selected randomly of whom 18 were males and 12 were females. The incidence of DC

among them was in the ratio of 2.5:1 in our study. There are many other studies with results showing male predominance but the reason for this gender bias is not known. Study conducted by Baykul et al. [24] had 1.3:1, male to female ratio with cystic changes in the follicular tissue. Daley and Wysocki [25] also reported male predominance in their study and according to them the rationale behind it could be that females opt for prophylactic extraction of impacted lower third molars because of smaller jaw size. Studies by Shear [26], Bernick [27] and Browne [28] also had similar findings. The age group ranged from 18 to 30 years. Young adults were considered, because studies have shown that as age increases there will be an increase in pathologic changes [27]. The eruption of lower third molars begins between the age group of 17.5–20 years, with a mean of 19.5 years for Asian Indian population [28]. Time of eruption varies considerably between populations ranging from 14 years in Nigerians to 24 years in the Greek, with males 3–6 months ahead of the females. Considering this observation, according to Hattab [29], the average age of eruption of the lower third molar is 20 years and may continue in some patients until the age of 25 years. In our study we found that 20% of the patients in the age group of 18–20 and 35.3% of the patients in the age group of 21–25 years had DC changes their follicle around ILTM's. Baykul et al. [24] in his study also had similar results, where in 56% of the patients older than 20 years had cystic changes and most of them occurred between the age group of 20–25 years. Studies conducted by Adelsperger et al. [10], Glosser and Campbell [20], Knights et al. [9] also support the above results.

In this study we have included impacted lower third molars with a pericoronal space of less than 2.5 mm. There are various measurements taken into consideration by different authors for distinguishing between cystic and normal pericoronal radiolucency. According to Eliasson and Heimdahl [30], pericoronal space less than 2.5 mm is nonpathological. The critical width of the follicle as stated by Dachi and Howell [31], is 2 mm. Ahlqwist and Grondahl [32] conducted a study with 12 year follow up on patients with a pericoronal radiolucency of 3–4 mm and found no pathological changes associated with them. According to them 4 mm pericoronal radiolucency can also be a normal follicle but this has not been universally accepted. Shear [26] suggested that some unerupted teeth have a slightly dilated follicle in the pre eruptive phase and this should not be mistaken for a cyst. It is cystic if the radiolucency is between 3 and 4 mm.

But according to Glosser and Campbell [20], Adelsperger [10] and Rakprasitkul [33] it is important to co relate histological and radiographical findings since the incidence of histologically pathological lesions is higher. We found in our study that the highest incidence of histological cystic changes was in the perifollicular space measuring 0–1 mm. Our result is similar to the result of the study conducted by Baykul et al. [24], where in 50% of patients had cystic changes in the follicle with radiolucency measuring less than 2.5 mm.

Histologically two different Oral Pathologists analyzed the dental follicles independently. The presence of lining epithelium was noted in 60.3% of the follicles in foci, or segments or in a continuos pattern. Out of this reduced enamel epithelium was present in 16.7% and no epithelial lining was seen in 40% of the follicles in the present study (Table 5, Fig. 7). Our findings relatively coincide with the study results by Damante and Fleury [13] regarding the presence of reduced epithelial lining in the follicles. In their study 68.4% of the follicles had reduced enamel epithelium lining and 13% of the follicles had no epithelial lining present. The loss of epithelium may be because of the ameloblastic attachment of the enamel cuticle, which detach from parts of the specimen during the surgical

**Table 5** Histopathological findings

| Histopathological findings | Number ($n = 30$) | % | 90%CI |
|---|---|---|---|
| DF-A | 7 | 23.3 | 13.2–37.9 |
| Others | 23 | 76.7 | 62.1–86.8 |
| DF-B | 5 | 16.7 | 8.4–30.5 |
| DF-C | 6 | 20.0 | 10.7–34.3 |
| DF-X | 12 | 40.0 | 26.7–54.9 |

*DF-A* dental follicle lined by stratified squamous epithelium

*DF-B* dental follicle lined by reduced enamel epithelium

*DF-C* dental follicle with fragmented epithelium

*DF-X* dental follicle with no epithelium

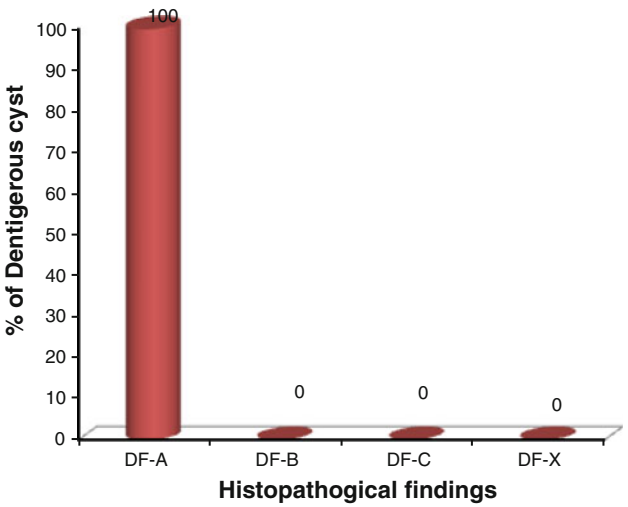


**Fig. 7** Incidence of dentigerous cyst according to histopathological findings

extraction. But Stanley et al. [34], have stated that surgical care does not contribute much to the presence or absence of the epithelial lining of the follicles

According to Glosser and Campbell [20] and Curan et al. [21] the histologic definition of a dentigerous cyst is any soft tissue specimen which is lined with stratified squamous epithelium spreading along the surface of the follicles [30]. Aldersperger et al. [10] in his study demonstrated an association between squamous metaplasia and proliferative activity of the epithelium using proliferative cell nuclear antigen. According to the authors squamous metaplasia is not a normal sequelae in follicle maturation but depicts early signs of pathology. Conflicting views have been put forward by other authors, according to Stanley et al. [34], Kim and Ellis [17], and Knights et al. [9], dental follicles in older patients are always lined by stratified squamous epithelium. In a study conducted by Stanley et al. all patients above the age of 26 years had follicles lined by squamous epithelium rather than the reduced enamel epithelium.

The hypothesis put forward by Browne [28] is that since the attachment of the squamous epithelium to the enamel is inferior as compared to that of the reduced enamel epithelium, there is high probability of cystic development in such cases. In the present study 23.3% of the follicles were lined with stratified squamous epithelium with cystic changes. Curran et al. [21] studied histologic changes in non pathologic follicular tissue. Pathologically significant lesions were diagnosed in 32.9% of the cases with DC being the highest (77.5%).

We have also found that DC is commonly associated with vertically ILTM's (42.9%). 33.3% of the DC was associated with distoangularly and horizontally ILTM's each. Mesioangularly impacted teeth did not have any associated cystic change in its follicles (Table 6, Fig. 8). Knutsson et al. [35], Eliansson and Heimdahl [30] reported a higher incidence of cystic changes in horizontally ILTM's. Only Baykul et al. [25] reported a high incidence of cystic changes associated with vertically ILTM'S

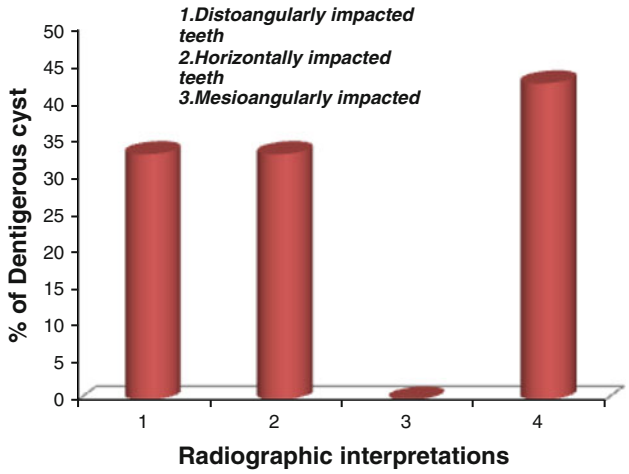


**Fig. 8** Incidence of dentigerous cyst according to type of impaction

followed by horizontally and mesioangularly impacted ILTMS's.

Thus the above data suggests that there is statistically significant incidence of Dentigerous cyst changes in the radiographically normal impacted lower third molars. It also suggests that the absence of radiographic feature is not reflective of the absence of any pathology. All the above mentioned data suggest that early removal of the ILTM when they are asymptomatic should be considered.

## Conclusion

Through this study we conclude that there is a high probability for the follicle around the normal asymptomatic impacted lower third molar to be a warehouse of potentially significant pathologies like DC. Diagnosis should not only rely on radiographs, but should co relate sufficiently with the histopathological examination. Hence biopsy of the follicle should be considered essential in every impacted lower third molar with pericoronal radiolucency.

**Table 6** Incidence of dentigerous cyst according to type of impaction

| Type of impacted teeth | Number ($n = 30$) | Dentigerous cyst | | $P$ value |
|---|---|---|---|---|
| | | No | % | |
| 1. Distoangularly impacted teeth | 6 | 2 | 33.3 | 0.562 |
| 2. Horizontally impacted teeth | 6 | 2 | 33.3 | 0.562 |
| 3. Mesioangularly impacted teeth | 11 | – | – | – |
| 4. Vertically impacted teeth | 7 | 3 | 42.9 | 0.219 |
| Total | 30 | 7 | 23.3 | – |

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