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RESEARCH ARTICLE

ASSOCIATION OF LATERAL CANALS WITH NON INFLAMMATORY JAW SWELLINGS – A STUDY WITH STEREOMICROSCOPE

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ABSTRACT

Inflammatory jaw swellings such as periapical abscess, granuloma and periodontal lesions are very frequently seen in jaws. One of the causes of such lesions is the presence of lateral canals. In contrast non inflammatory jaw swellings such as odontogenic cyst tumors, benign and malignant neoplasms of jaws are caused by various genetic alterations of cells but only in selected population. The cause for such genetic alterations within cells, present in periodontium, is still not yet completely understood. Additionally the relationship of lateral canals and various genetic alterations present in the neoplasms have not been yet established. Therefore this preliminary study was conducted to evaluate the lateral canalson extracted teeth from resected specimens under stereomicroscope using clearing technique and to establish a possible correlation of lateral canals with such neoplastic lesions of jaws.

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INTRODUCTION

Dentists come across various types of jaw swellings which could be inflammatory and non-inflammatory in origin andit is very easy to determine the causative factors associated with inflammatory jaw swellings and to treat them permanently. In contrast, non-inflammatory jaw swellings i.e., cystic lesions and various neoplasm are caused by abnormal proliferations of cells. The cause for such proliferation is still not completely understood though there have been various etiological factors mentioned in the literature. Therefore most of the time recurrence is seen even after proper treatment plan. Review of literature shows presence of lateral canals in the teeth changes the micro environment of the periodontium which contains numerous types of tissues. (Raja *et al*., 2008) The cause and effect relationship of lateral canals has been well established in inflammatory jaw lesions but not yet explored in non-inflammatory jaw lesions i.e. cystic lesions and other benign and malignant intraosseous lesions of the jaws. Therefore this preliminary study evaluated the presence of lateral canals in non-inflammatory jaw swellings.

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Aims and Objectives

1. To find out the presence of lateral canal in tooth associated with non-inflammatory jaw swellings.
2. To establish correlation between the lateral canal and type of the lesion.

MATERIALS AND METHODS

This retrospective preliminary study was conducted from June 2015 to November 2015 in the department of oral pathology. No ethical clearance was required for this study as the study

was conducted on archival specimens and did not contain any studies with human participants or animals. Additionally patient's identity has not been revealed. Surgically excised specimens (Hemimandibulectomy, hemimaxillectomy, segmental resections) (Fig.1a) of odontogenic tumors and cysts were randomly selected from archives.

Sample selection

Exclusion criteria- Inflammatory jaw lesions
Inclusion criteria- Specimens of non-inflammatory jaw lesions with sufficient clinical data were included.

Control group (sample size 15) Control group was further divided into positive control (sample size: 5) comprised of teeth associated with periapical and periodontal diseases and negative control (sample size: 10) which included completely normal teeth from patients who underwent orthodontic extractions.

Study group (sample size 20) (Table 1)

Table 1. The samples along with the number of each samples in study group

Lesions	Number of samples
UnicysticAmeloblastoma(3+1)	4
PlexiformAmeloblastoma(3+1)	4
DesmoplasticAmeloblastoma(5+0)	5
Central giant cell granuloma(0+1)	1
Capillary Haemangioma(0+1)	1
Central neurofibroma(0+1)	1
Osteosarcoma(0+1)	1
Dentigerous cyst(0+1)	1
OKC(0+1)	1
Odontoma(0+1	1

Selection of teeth

Teeth were extracted from the excised specimens and were labeled. (Fig. 1b) The main tooth associated with the swelling was prime criteria when such teeth were absent or showing incomplete rootformation then immediate adjacent tooth was selected. Extracted teeth were cleaned by removing calculus and debris manually.

The clearing technique used here was the one described by Mahesh Maralingannavar *et al.* (2010). Access cavity was prepared on extracted teeth with the help of long shank roundbur using air-rotor hand piece. (Fig.1c) Bur was allowed to penetrate parallel to the long axis of the tooth till it was dropped into the pulp chamber and canals were located with an explorer. To maintain the internal anatomy of the pulp chamber and radicular portion of the tooth, use of endodontic instruments like files or reamers were avoided. Teeth were then placed in 5.25% sodium hypochlorite solution for 24 hours to clear organic debris. Then the teeth were flushed with distilled water loaded in a 23 gauge needle. This facilitates the debris and residual sodium hypochlorite to flush out and allows the canal to be patent. To ensure the patency of the canals distilled water was forcefully flushed through the canal orifice and a jet pattern was observed from the apex of the tooth. (Fig.1d) Those teeth which did not show the emergence of water through the apex were discardeddue to the lack of patency.

Decalcification and Clearing of teeth

Extracted specimens were decalcified for 4 to 6 days in 10% nitric acid. Teeth were individually labeled and tied in gauze piece.

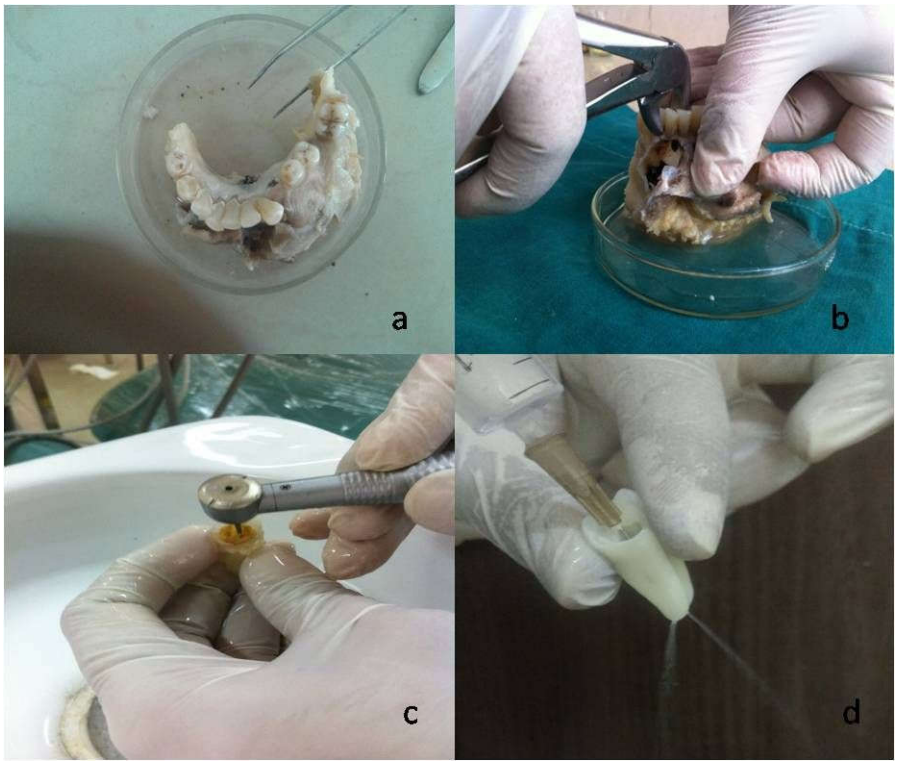

Figure 1a: Surgically excised specimens in study group, Figure 1b : Teeth were extracted from the specimen, Figure 1c : Access opening made on samples, Figure 1d: 'jet' pattern observed at the apex when distilled water is flushed through the canal orifice. Two jet patterns indicate presence of one lateral canal

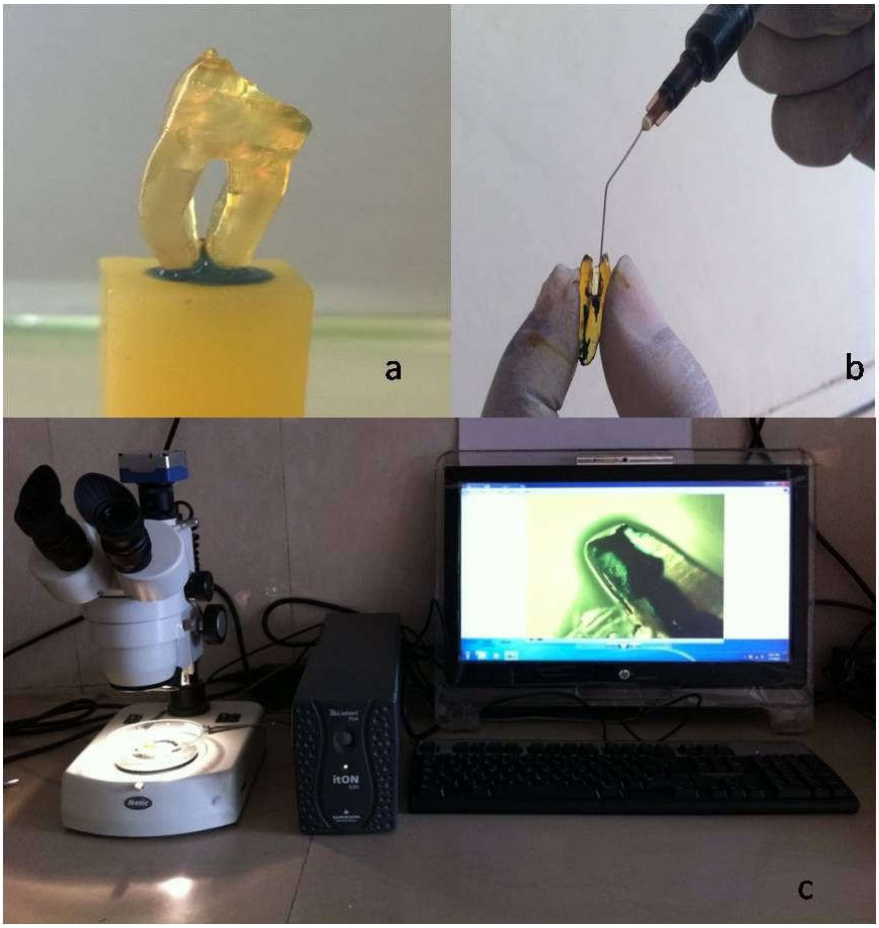

Figure 2a: Transparent tooth specimen after clearing, Figure 2b: Injection of methylene blue dye, Figure 2c: Stereomicroscope. Model no *(MOTIC SMZ-143 SERIES)*

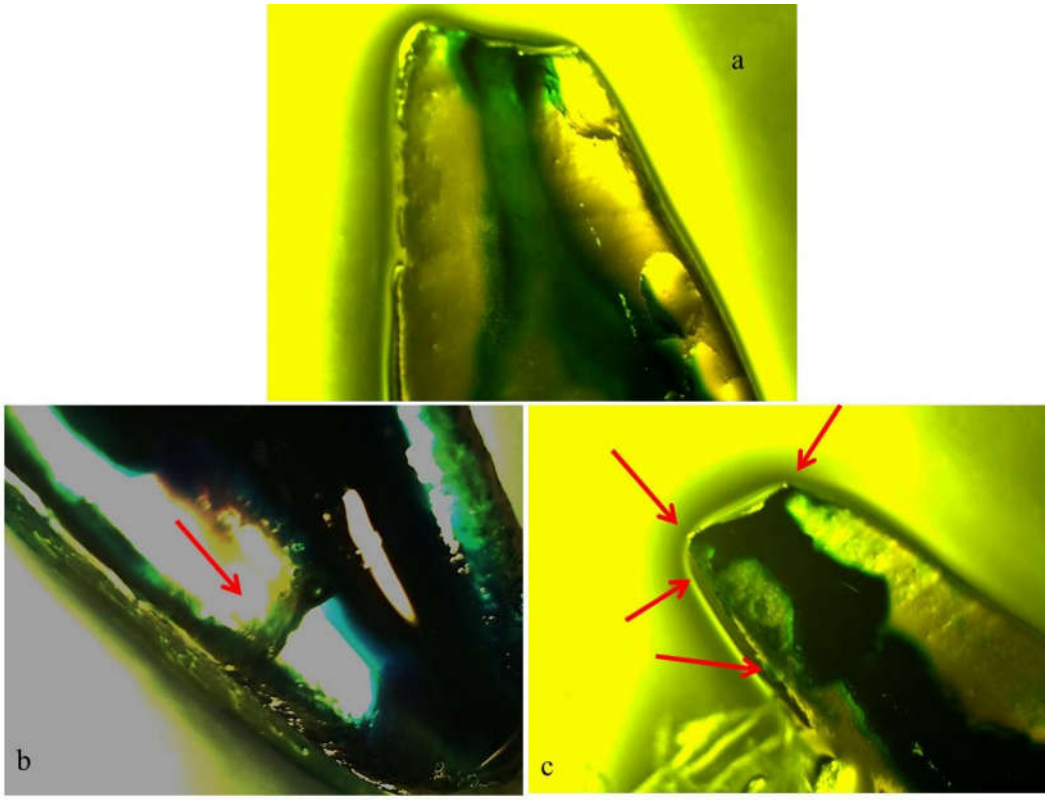

Figure 3a. Absence of lateral canals in negative control group under stereo microscope, Figure 3b and 3c. Presence of lateral canals in study group under stereomicroscope

Nitric acid was changed at least 3-4 times every day and the bottle was shaken several times a day to hasten the process of decalcification. Needle test was done to find out the degree of calcification. Decalcified teeth were kept under running water for 12 hours followed by dehydration with different grades of alcohol (ethyl alcohol) i.e. 80% for 12 hours, 90% for one hour and three changes of absolute alcohol for one hour each. The specimens were then cleared in methyl salicylate for 15-30 min. Teeth attains a beautiful glass like appearance (Fig.2a). Methylene blue dye was injected into the access opening with a 27 gauge needle, drop by drop (Fig.2b). A syringe barrel was used at the apex for attaining a negative pressure to pull out the dye through the apex. A thin brass wire was used to remove the air entrapment inside the canal and thus facilitates the flow of dye. Once the dye has reached the apex the main canal and its accessory canals are observed under stereomicroscope. Model no (MOTIC SMZ-143 SERIES) (Fig. 2c,3a,3b,3c)

OBSERVATIONS AND RESULTS

All the findings were tabulated and statistically analyzed with chi square test. When all the samples were evaluated and compared to find out the presence and absence of lateral canals it was observed that in negative control group lateral canals were absent in 4 samples and in positive control group 4 samples had the presence of lateral canals.

In study group 13(65%) samples contained lateral canals and thus a significant p value (p=0.032) was attained (Table 2). Thus there was statistical significant relationship between lateral canals and non-inflammatory jaw swellings. When the number of lateral canals were assessed in both study group and control group it was found that 30% of the samples contained only one lateral canal 26.7 % contained 2 lateral canals and 1 % showed 3 lateral canals and 40% showed no lateral canals (Table 3). When the presence and absence of lateral canal was observed individually in each type of lesion except for central capillary hemangioma, odontoma and osteosarcoma all other lesions showed the presence of lateral canals. The presence of lateral canal in main tooth with the adjoining teeth was also compared and it was found the rate of presence of lateral canals were more in the adjoining teeth when compared to the associated teeth. (Table 4)

Table 2. The distribution of samples with lateral canals present

Distribution of samples with Lateral Canals Present

	Lateral Canal		
	Absent	Present	Total
Negative Control	4 (80%)	1 (20%)	5
Positive Control	1 (20%)	4 (80%)	5
Study Group	7 (35%)	13 (65%)	20
Total	12 (40%)	18(65%)	30

Chi-square = 4.287, degrees of freedom =1, p =.032, Significant

This table shows distribution of samples with lateral canals present in three groups. The proportion of lateral canals present in each group was compared using chi-square test for association between attributes. The result indicates that there is significant difference in the proportion lateral canals present in negative control group and study group. (chi-square = 4.287, df = 1, p = .032)

Table 3. The number of lateral canals present /absent according to groups

Number of Lateral Canals Present according to groups

Group	Number of Lateral Canals			
	Absent	1 Lateral Canal Present	2 Lateral Canals Present	3 Lateral Canals Present
Negative Control	4 (80%)	1 (20%)	0 (0%)	0 (0%)
Positive Control	1 (20%)	3 (60%)	1 (20%)	0 (0%)
Study Group	7 (35%)	5 (25%)	7 (35%)	1 (5%)
Total	12 (40%)	9 (30%)	8 (26.7%)	1 (3.3%)

Table 4. The distribution of lateral canals according to the tooth selected (same tooth /adjacent tooth associated with the lesion)

Distribution of lateral canals according to tooth selected		
Selected tooth	frequency	percentage
Same tooth Associated with the lesion	8	40.0%
Adjacent	12	60.0%
Total	20	100.0%

DISCUSSION

Accessory canals are defined as pathways from the radicular pulp, extending laterally through the dentin to periodontal tissue seen especially in the apical third of the root. They are called lateral canals, because they are usually located on lateral surface and open into the periodontium. These canals form when the epithelial root sheath breaks down before root formation (Nanci and Ten, 2003; Orban and Bhaskar, 1991; Avery, 1987) They are responsible for various periodontal infections i.e. inflammatory jaw lesions which was first described by Simiring and Goldberg in 1964. (Simring and Goldberg, 1964; Bakland *et al*., 2008) and (Rubach and Mitchell, 1965)On the other hand non-inflammatory jaw swellings such as odontogenictumors, cysts, and various intraosseous benign and malignant lesions of the jaws occur due to proliferation of lesional tissues derived from adjacent normal cells. The exact stimulus for such proliferation is still not completely understood. The histological constitution of the jaw is similar in all the individuals but the pathological alterations in such normal tissues are seen only in selective population. Researchers have proposed various theories for such alterations such as genetic alterations and mutations etc. (Klatt E Kumar, 2015) but the stimulus for such alterations and proliferations of tissues in non-inflammatory jaw swellings is still not completely explored and most of the times it is questioned even by the patients who are victims of such lesions where the clear evidence of etiological factors can't be established on clinical examination. Therefore this preliminary study was conducted to establish the correlation between the lateral canals and non-inflammatory jaw swelling.

Lateral canals are considered to change the microenvironment of the periodontium (Raja *et al*., 2008; Orban and Bhaskar, 1991). Therefore it was thought to explore the presence of lateral canals in the teeth which are chiefly associated with such jaw swellings. Main tooth associated with swelling was

the criteria for selection in study group. When such teeth were absent or showing incomplete root formation such as in dentigerous cyst or ameloblastoma then adjacent tooth was selected to, validate the hypothesis hypothesis that it could be source of the of various pathologies..When numbers of lateral canals were compared between main tooth and adjacent tooth it was found that there was not much difference between both .Thus, the lateral canals present in both the main tooth and adjacent tooth could be responsible for etiopathogenesis of various non-inflammatory jaw swellings. Therefore it could be hypothesized that the presence of lateral canals in immediate adjacent teeth could also be responsible for alterations in the microenvironment of the erupting third molar .

According to Glickman lateral canals open up in the periodontal ligament space where cell rest of malassez are present and are responsible for their abnormal proliferations giving rise to various odontogenic cysts and tumors. Lateral canals suggested to be interconnecting pathways between the pulp and the periodontium and contain connective tissue and blood vessels that connect the circulatory systems of the two tissues and therefore could act as a medium of transport for various biomolecule responsible for the change in the milieu of various tissues in and around the periodontal ligaments. (Cohen and Hargreaves, 2006) Therefore lateral canals could be considered as a co-factor in the etiology of non-inflammatory jaw swellings. According to Rubach and mitchel, lateral canals are mostly associated with molars, current study also had maximum molar samples associated with odontogenic tumors and cysts (S F. 1984) In this study, 65% samples in study group showed presence of lateral canals. The genetic composition of every cell of the body is very sensitive to the changes in the extra cellular environment, as suggested by Mohit *et al*. in his extensive review article in 2015 (Sharma *et al*., 2015). Therefore it could be hypothesized that the transmission of inflamed pulpal contents through lateral canals with in the periodontium in the middle and older age groups could be responsible for neoplastic alterations of tissues.

In this study lateral canals were observed in few samples of negative control group. But absence of lesions in this group could be due to the absence of other systemic and local etiological factors. After access cavity preparation, dye was injected and care was taken to immediately observe the tooth under stereomicroscope as the dye would immediately diffuse into the dentinal tubules obscuring the canal interpretation. To prevent the dye diffusion into the dentinal tubules, Mandana Naseri *et al.* in 2012 modified this technique by injecting a dye before decalcification. Also it has been observed that, tooth becomes transparent after clearing but if it comes in contact with air again while assessing the canal pattern, specimen turns out to be hazy and may prevents the visibility of the dye penetrated through the canal. This is a temporary change and can be rectified by putting the specimen back into clearing solution. Also care should be taken to retain the specimen in the clearing agent till the dye is injected and assessed. Thus odontogenic tumor /cyst and various benign and malignant neoplasm which shows abnormal proliferations of various cells could be due to the change in the surroundings of extracellular microenvironment brought about by accessory /lateral canals opening in periodontal ligament carrying various pulpal biomolecules in periodontium which could alter the genetic alteration of cells.

Conclusion

Therefore it can be postulated that lateral canals could be a co factor along with other etiological factor to play a crucial role in the pathogenesis of non-inflammatory jaw swelling. Also such studies should be standardized with more sample size and equal number of samples in each group to explore the role of lateral canals. Involved teeth should be scanned with the help of CBCT before decalcification to locate the openings of lateral canals on the cemental surface in vivo as well as in vitro.

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