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# Interglobular Dentine: A Short Study

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**KEYWORDS**

Interglobular Dentine, Hypomineralised structures, Vit. D deficiency

**ABSTRACT:**

Interglobulardentin is a hypomineralized/ partially mineralized area of dentine which can be seen both in crown below the mantle dentine near the dentino enamel junction or in the root just below the tomes granular layer. The present study was designed to examine the distribution of interglobular dentine in human teeth. In the present study 100 longitudinal ground sections were prepared from permanent teeth that were extracted for orthodontic reasons. All teeth were free of caries and periodontal diseases. Out of the coronal and radicular dentine interglobular dentine was seen more in coronal than the radicular dentine. The most common location in crown is middle third followed by cervical third and coronal third. In the radicular dentin, site of the interglobular dentine was cervical third of root followed by middle third.

## Introduction

Interglobular dentine represents a developmental defect of the teeth with an area of hypo mineralized dentine. It consists of arc shaped areas of less/poorly mineralized dentine and arises when the calcospherite globules of mineralization of dentine fail to fuse.[1,2,3,4] There is a very close relationship between interglobular dentine and mineralization disorders/defects which can be both inherited and acquired. As a result, histological studies involving analysis of interglobular dentine are becoming more and more popular to know the precise chronologic information regarding such defects.[4] Interglobular dentine is seen frequently in the circumpulpal dentin. During mineralization, globular masses fuse to form calcified mass. When these globular masses (calcospherites) fail to fuse into homogenous mass, it leads to formation of interglobular dentin. The formation of interglobular dentin is coincident with retraction of odontoblast process.[5,6] Tsuchiya et.al suggested that the retraction of odontoblast processes is responsible for the formation of interglobular dentine. They also suggested that the delay in calcification caused by retraction of odontoblat process leads to formation of hypomineralized regions. The extent of odontoblast process varies in different regions of the crown and root. Thus the pattern of distribution of interglobular dentine also varies.[5,6]

## Aim

The aim of the present study was to identify the most common site of interglobular dentine in the tooth in the population of tricity area (Mohali, Chandigarh, Panchkula).

## Material and Methods

For the present study, 100 extracted teeth were collected from various dental clinics and hospitals of tricity region (Mohali, Chandigarh & Panchkula). Detailed history was taken prior to collecting the extracted teeth. For the present study only those teeth that were included that were extracted for orthodontic treatment

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purposes and that too without dental caries, attrition, and periodontal disease. Subsequent to extraction, the extracted teeth were placed in hydrogen peroxide for 48 hours and then in 10% formalin for 24 hours. Using an Arkansas stone, the teeth were then reduced mesio-distally till the desired thickness was achieved. All measures were taken to maintain a uniform thickness of all the ground sections. After achieving the desired thickness, the teeth were mounted without staining using DPX mounting media (D.P.X. Mountant for microscopy-MERCK) on to a glass slide. To avoid biased result, the teeth were observed by two evaluators under a light microscope (Olympus CH20i, Olympus (India) Pvt. Ltd).Photomicrographs of the representative sites were also taken by using Microscope camera (1.5 MP, 1/2.5" color USB2.0 ONSEMI CMOS Sensor) with fixed microscope Adaptor (FMA 050).To observe the distribution of the interglobular dentine, the tooth ground sections were divided into the crown and root portion. The crown portion was further divided into the cervical, middle and occlusal/coronal portions. The root was similarly divided into cervical, middle and apical one thirds.

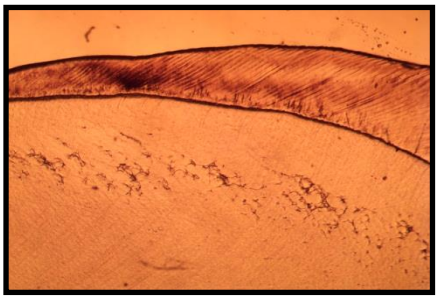

**Figure 1:** 4X view of Interglobular dentine in coronal dentine

**Figure 2:** 10X view of interglobulardentine below dentino-enamel junction and dentinal tubules passing uninterrupted through it

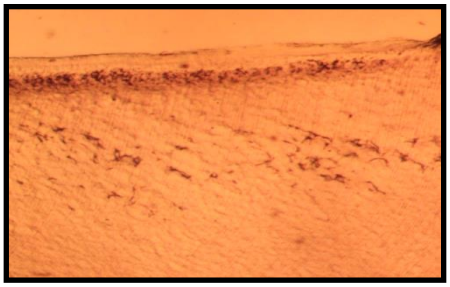

**Figure 3:** 4X view of Interglobular dentine in root just below the Tome's granular layer

**Figure 4:** 10 X view dentinal tubules passing uninterrupted through interglobular dentine

**Figure 5:** 10X view of interglobular dentine showing dentinal tubules passing uninterrupted through it

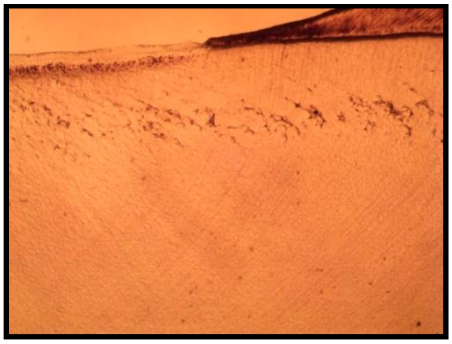

**Figure 6:** 4X view of interglobular dentine seen in both crown and root

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**Results**

In our study of 100 ground sections the results are depicted in Table 1. Out of 100 tooth sections, interglobular dentine was observed both in the crown and root in 91 ground sections whereas09 ground sections did not show the presence of interglobular dentine in the crown or the root. Out of the crown and root, interglobular dentine was seen more in crown (80 ground sections) than in the root (53 ground sections).In the crown, the interglobular dentine was seen more in middle one third of the crown (59 ground sections) followed by cervical one third and coronal one third. In the coronal dentine the location of interglobular dentine was in the circumpulpal dentine below the mantle dentine near the dentino-enamel junction (DEJ) as shown in Figures 1,2. In the root portion the interglobular dentine was seen more in cervical one third (46 ground sections) followed by middle one third and apical one third. In the radicular dentine the interglobular was seen just below the Tome's granular layer as seen in Figure 3. The presence of interglobular dentine in two or more than two areas was also observed. In the crown 35 ground sections and in the root portion12 ground sections showed such areas whereas33 ground sections showed interglobular dentine both in crown and root, Figure 6. Care was taken to identify and exclude defects like air bubble entrapment in slide and mounting artifacts. To further emphasize, in our study it was also observed that in all the ground sections the dentinal tubules could be seen passing uninterrupted through the interglobular dentine as shown in Figure 2,4,5.

| Total No of longitudinal ground sections | Interglobular dentine in crown | | | Interglobular dentine in root | | | Interglobular dentine both in crown and root | Complete Absence both in crown and root |
|---|---|---|---|---|---|---|---|---|
| 100 | 80 | | | 53 | | | 33 | 09 |
| | Coronal | Middle | Cervical | Apical | Middle | Cervical | | |
| | 22 | 59 | 41 | 06 | 17 | 46 | | |
| | Seen in 2 or more than 2 locations | | | Seen in 2 or more than 2 locations | | | | |
| | 35 | | | 12 | | | | |

**Table 1**

**Discussion**

In the dentine, three different types of mineralization or deposition of hydroxyapatite crystal pathways have been documented. In the first pathway the matrix vesicles of the odontoblats provide the nucleation sites for the mineralization which is seen during the mineralization of the organic matrix of mantle dentine. However, the majority of the mineralization of the dentine takes place by the second pathway of extracellular matrix molecules derived mineralization. The third pathway is the serum derived mineralization. Mineralization of the dentine can take place linearly as well as in a globular pattern which is also known as the spherulitic method. In the spherulitic method, there is deposition or formation of calcifying globules that have been named calcosherites at multiple sites in dentine which increase in size and fuse with the adjacent globules.[7,8] Some researchers also propose that the mineralization of dentine occurs in two phases or steps name primary mineralization and secondary mineralization. During primary mineralization, it is said that partial mineralization of the dentine takes place by the globular deposition of the hydroxyapatite crystals in the collagen fibers which is followed by secondary mineralization in which new areas of globular mineralization form in the partially mineralized dentine. However these new globular masses of secondary mineralization do not fuse with one another completely and give rise to arc shaped hypomineralised areas known as interglobular dentine.[7,8,9] Many researchers has also studied the role of odontoblast processes in the mineralization and have observed thatodontoblast

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processes play an important role in the mineralization of the dentine and have found that the absence or presence of these processes may have a direct effect on the formation of interglobular dentine. It has been shown that the odontoblast processes in the cuspal dentinal tubules extend right up to the dentino enamel junction and these processes remain there throughout their life span and that is why interglobular dentine is least seen in the cuspal regions of coronal dentine as was also observed in our study. However the odontoblast processes do not reach the dentino enamel junction in the middle and cervical regions of the coronal dentine. Absence of odontoblast processes promotes the formation of interglobular dentine in these areas as was seen in our study where majority of interglobular dentine was seen in the middle and cervical regions of coronal dentine. Similarly the odontoblast processes fail to reach the outer surface of dentine in the radicular dentine in the cervical and middle regions of the root and this is the site where majority of interglobular dentine is seen in our study also. The odontoblast processes reach the outer surface of dentine in the apical portion of the root and hence the interglobular dentine is least seen in the apical portions as was seen in our study.[5,6,10] However apart from the above mechanism of formation of interglobular dentine there are numerous other theories which have also been postulated for its formation. Some of the researchers observed in their studies that interglobular dentine was found more in those portions of dentine that were formed after birth and the dentine formed before birth was almost free of interglobular dentine. Hence it was assumed that the near optimal nutritional condition in utero favored better calcification of dentine and results in the absence of interglobular dentine. It also has been postulated that the rapid rate of deposition of dentine favors the formation of interglobular dentine. It was observed by some researchers that formation and calcification of dentine after eruption is slow. Fujita in their study observed that the interglobular dentine was produced when there was rapid or fast calcification of the organic matrix. The interglobulardentin is usually seen near the circumpulpal dentine just below the mantle dentine. The interglobular dentine is basically a defect in the mineralization of the organic matrix because the normal architecture of the dentinal tubules remains unchanged.[3,7,8] Development of the tooth even though genetically governed, is highly sensitive and susceptible to environmental changes or disturbances.[11] There are certain conditions that predispose a tooth to increased formation of interglobular dentine: dentine dysplasia, deficiency of vitamin D (Rickets). Patients suffering from rickets (Deficiency of Vit D) show deformities of the teeth especially in the dentine due to alterations in the levels of calcium and phosphorus.[10] The mineral homeostasis in the human body is governed by Vit D that controls/affects the intestinal and renal re-absorbtion of calcium and phosphorous. It also guides the mobilization and deposition of calcium and phosphorous in the mineralized tissues of the human body including the dentine and bone.[8,12,13,14] Studies were also conducted to understand the impact of Vit D deficiency on the health of our past societies, their daily activities, disease load and cultural habits. Evenin the teeth that have been burnt at 800 to 1000 degrees, as the enamel protects the underlying dentine from the heat; the interglobular dentine has been clearly demonstrated. Endocrine disorders namely hypothyroidism and hyperthyroidism in many studies also showed the presence of hypomineralised areas in dentine. Exposure to increased levels of fluoride at the time of mineralization of the organic matrix can also lead to formation of interglobular dentine.[8,16] The interglobular dentine can be viewed under reflected light in the ground sections. This interglobular dentine can be seen both in the crown and the root of the tooth as arc shaped areas of less mineralized dentine.[2,4,5,9] In a study conducted by Jayawardena C etal, interglobular dentine was more in crown portion than the root, with crown portion contributing to 90.38% cases.[5] Similar results were found in our study also where crown portion contributed to 80% of the cases showing interglobular dentine. In their study 82.23% of the cases showed presence of interglobular dentine in two or more than two locations in the crown.[5] In our study this percentage figure came out to be only 35%. The dentinal tubules run uninterrupted through the interglobular dentine as was seen in our study.[5] In the crown portion the most common location of interglobular dentine is the cervical one third as found in the studies conducted by Jayawardena C etal and Singh H et al.[2,5] However our results are contrary to these findings as the most common site of interglobular dentine in the crown portion in our study was middle one third and not

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cervical one third. In the root portion the most common site of occurrence of interglobular dentine is cervical one third as was seen in our study.[17] In a study by Jayawardena C atal 63.64% of the cases showed interglobular dentine at two or more than two locations in the root. This percentage in our study was 12%.

**Conclusion**

This present study like the previous studies supports that the location of interglobular dentine is very closely associated with the extent of odontoblats process in the crown and the root. Apart from the location of interglobular dentine in the crown and root, this interglobular dentine can also be very helpful in understanding the impact of Vit D deficiencies on the health of our past societies and populations, their cultural habits, daily activities and disease load prevalent in our past population and societies. As observed in our study, the dentinal tubules could be seen passing uninterrupted through the interglobular dentine, the role of dentinal tubules need to be studied more extensively in the formation of interglobular dentine andmore studies should be carried out to identify the role of diseases and Vit deficiencies in the formation of interglobular dentine. Further studies are also required for multirooted teeth to identify the root specific distribution of interglobular dentine.

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