DEPARTMENT OF ORAL AND MAXILLOFACIAL PATHOLOGY & ORAL MICROBIOLOGY

DENTIN

Study of dentin includes…

- **Physical properties**
- **Chemical properties**
- **Structure**
  - Dentinal tubules
  - Peritubular dentin
  - Intertubular dentin
  - Predentin
  - Odontoblast process
- **Primary dentin**
- **Secondary dentin**
- **Incremental lines**
- **Interglobular dentin**
- **Granular layer**
- **Innervation of dentin**
  - Intertubular nerves
  - Theories of pain transmission through dentin
- **Age and functional changes**
  - Vitality of dentin
  - Reparative dentin
  - Dead tracts
  - Sclerotic or transparent dentin
- **Development**
  - Dentinogenesis
  - Mineralization
- **Clinical considerations**

INTRODUCTION

- The dentin provides the bulk and general form of the tooth and is characterized as a hard tissue with tubules throughout its thickness.
- Since it forms slightly before the enamel, it determines the shape of the crown, including the cusps and ridges, and the number and size of the roots.
- As a living tissue it contains within its tubules the processes of the specialized cells, the odontoblasts. Although the cell bodies of the odontoblast are arranged along the pulpal surface of the dentin, the cells are morphologically cells of dentin because the odontoblasts produce the dentin as well as the odontoblst processes existing within it.

Physical properties of dentin

Color: yellow, becomes darker with age.

Transparency: semitransparent

Hardness: less than enamel but more than bone, it increase with age

Elasticity:
It is highly elastic. It provides flexibility to prevent fracture of overlying enamel.

Radio lucent because of less mineral content

Highly permeable because of dentinal tubules

CHEMICAL COMPOSITION:

Organic substance

(35%)

- collagen fibers
- ground substance

Inorganic substance

(65%)

- hydroxy appetite crystals
- small amounts of
  - phosphates, carbonates, sulfates, phosphorus, sodium, potassium, magnesium, lead, fluorine, chlorine, aluminum, silicone etc.

STRUCTURE:

The dentinal matrix of collagen fiber is arranged in a random network.

The bodies of odontoblasts are arranged in a layer on the pulpal surface of the dentin, and only their cytoplasmic processes are included in the tubules in the mineralized matrix.

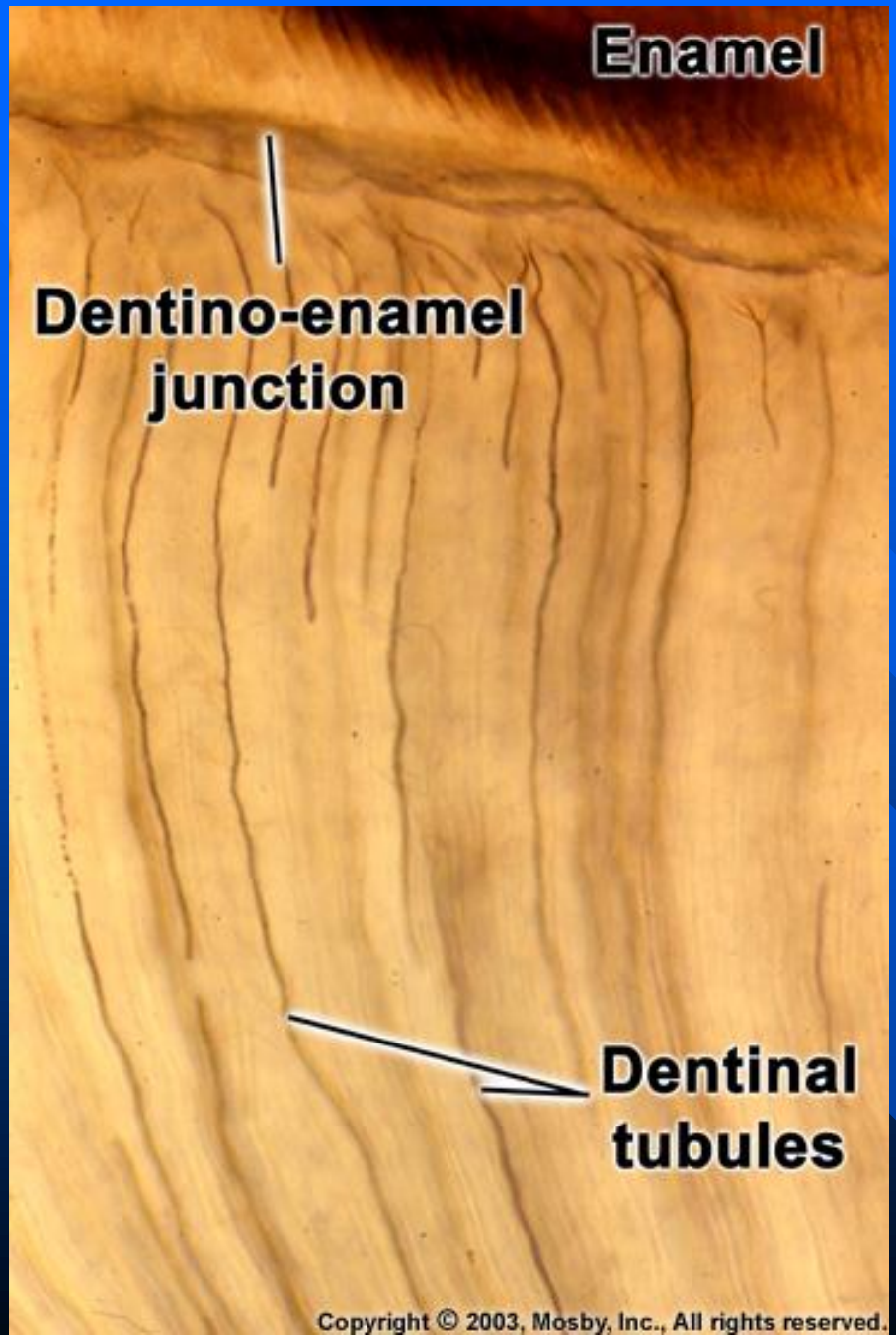
Each cell gives rise to one process.

DENTINAL TUBULES:

The course of dentinal tubules follows a gentle curve in the crown, less so in the root, where it resembles an S shape.

Dentinal tubules start at right angles from pulpal surface, and end perpendicular to the DEJ and DCJ.

The first convexity of the double curved course is directed toward the apex of the tooth.



Ground section of dentin showing the dentinal tubules in which the odontoblast processes run.

The ratio between th4 outer and inner surfaces of dentin is about 5:1.

They are larger in diameter near the pulpal cavity (3 to 4um) and smaller at their outer ends(1um).

The ratio between the numbers of tubules per unit area on the pulpal and outer surfaces of the dentin is about 4:1.

Near the pulpal surface of the dentin the number per square millimeter varies between 50,000 and 90,000.

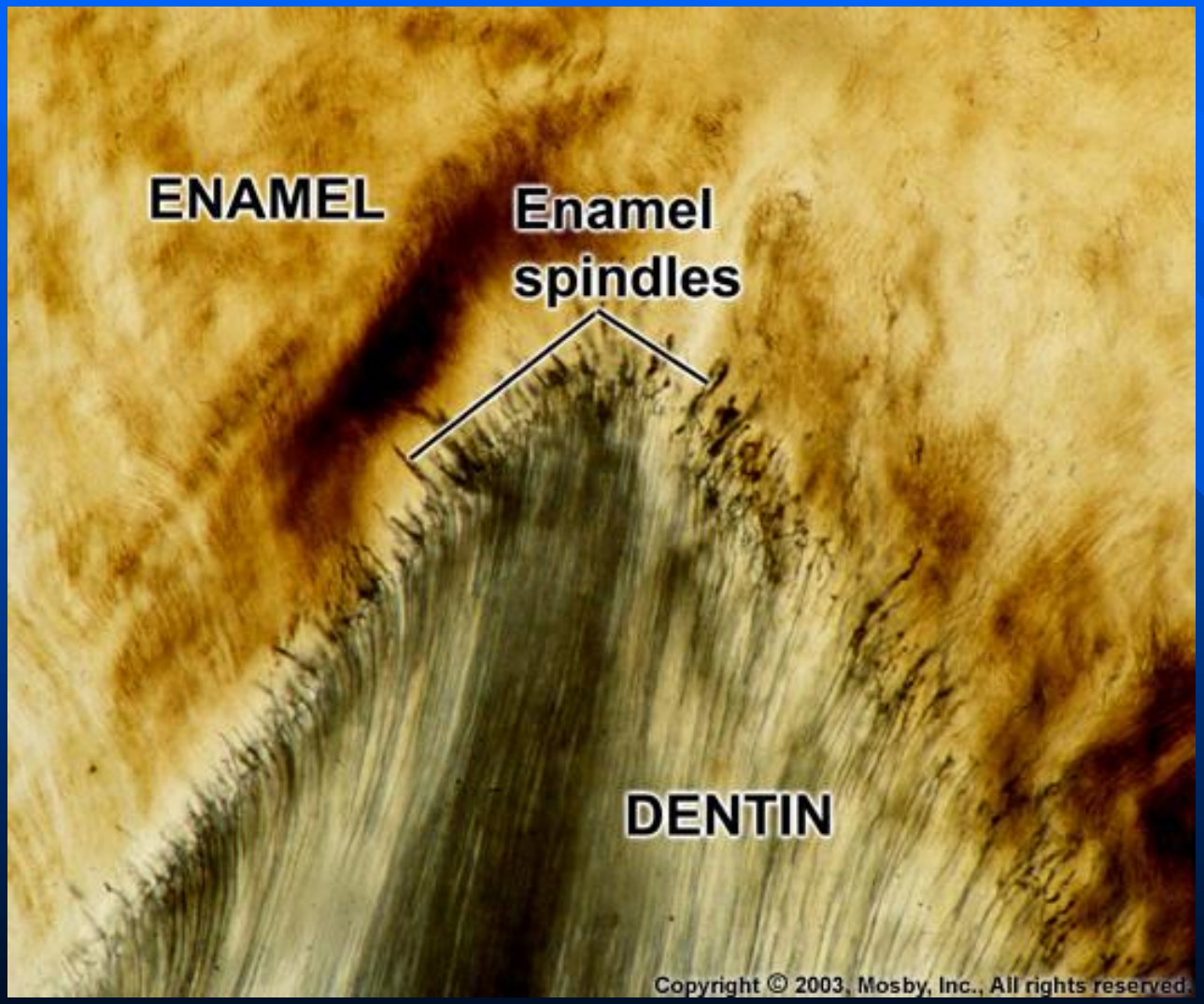
CANALICULI OR MICROTUBULES:

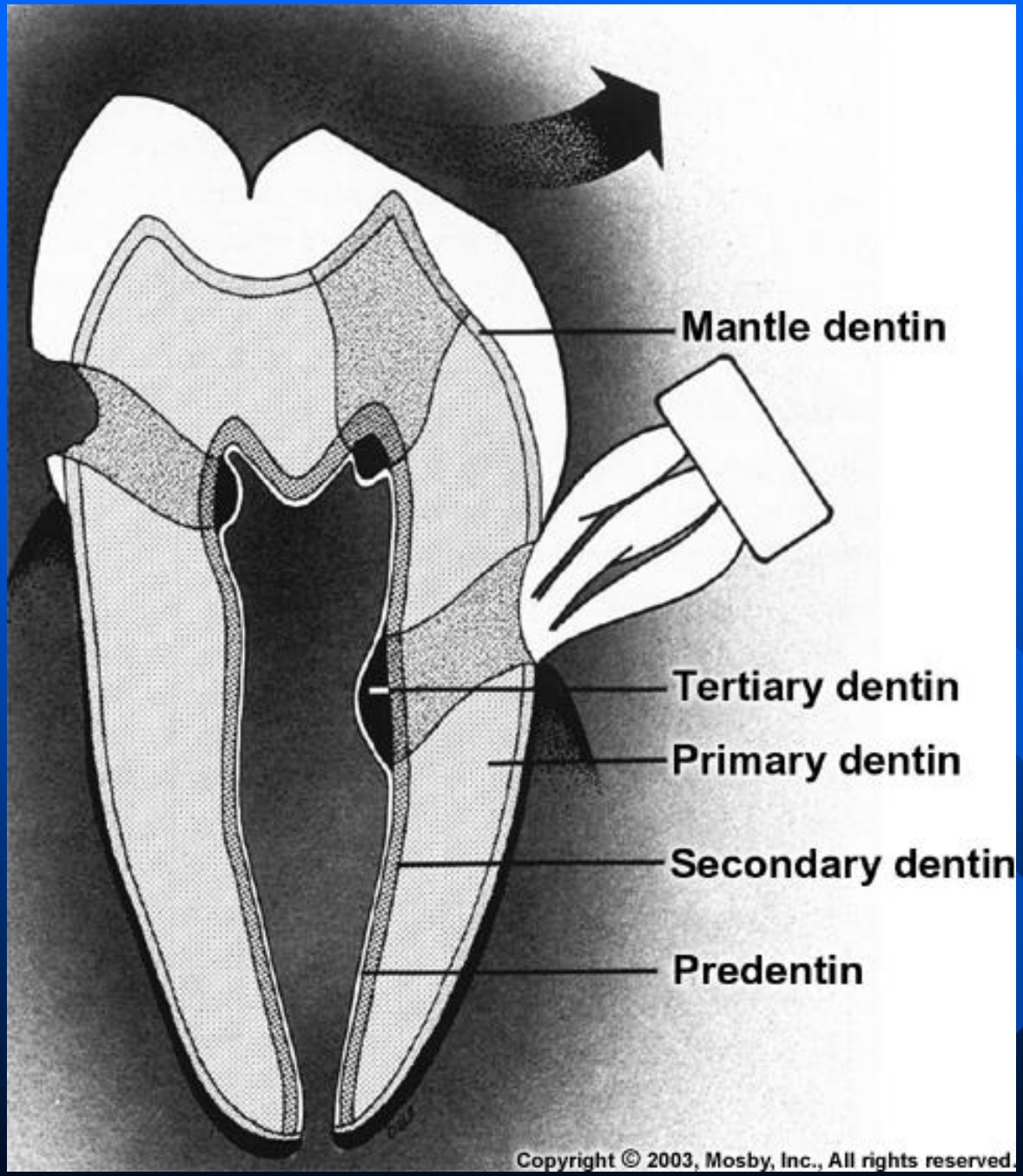
These are lateral branches from the dentinal tubules.

1 um or less in diameter

Originate more or less at right angle to the main tubule.

A few dentinal tubules extend through the dentinoenamel junction into the enamel for several millimeters. These are termed *ENAMEL SPINDLES.*

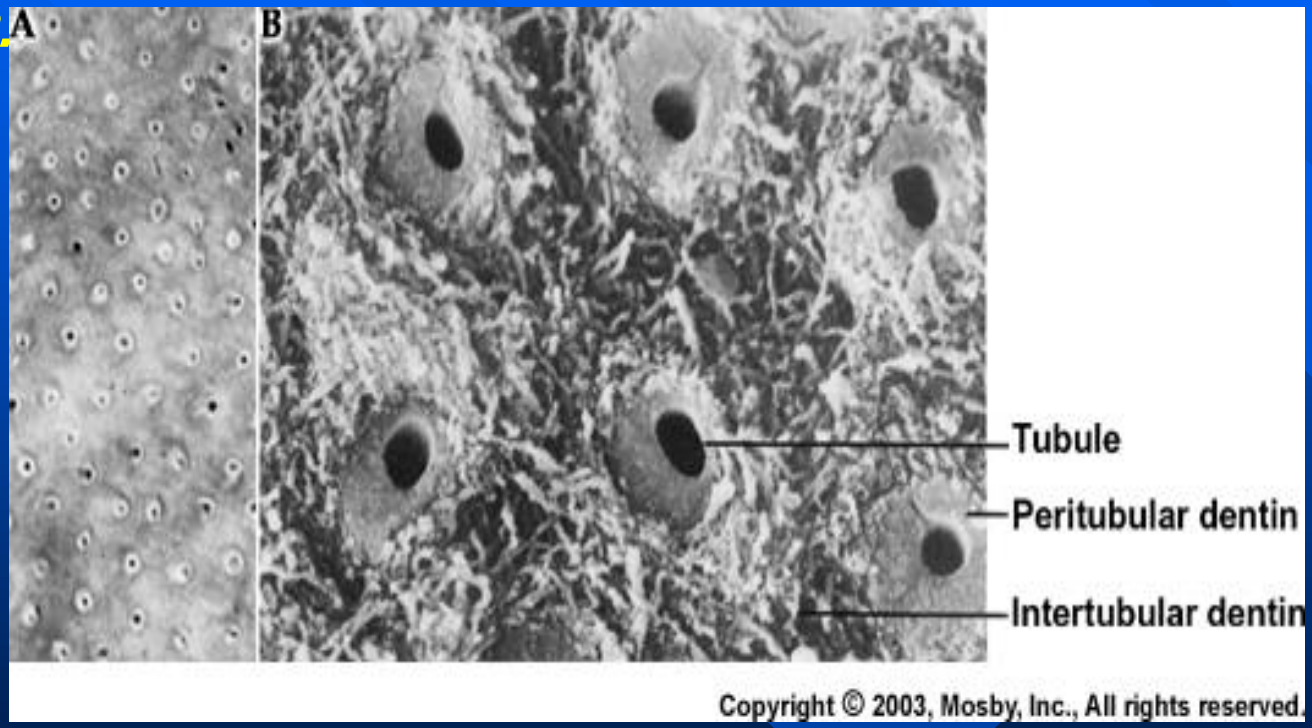




Terminology and distribution of dentin

PERITUBULAR DENTIN:

The dentin that immediately surrounds the dentinal tubules is termed *peritubular dentin*. It forms within the narrowing tubular lumen therefore it can be called as *intratubular dentin*.



(A) light microscopy and **(B)** scanning electron microscopy. The dark central spots are empty dentinal tubules surrounded by a well-defined collar of peritubular dentin.

It is more highly mineralized than intertubular dentin

By its growth, it constricts the dentinal tubules to a diameter of 1 um near the DEJ.

The calcified tubule wall has an inner organic lining termed the lamina limitans. This is described as a thin organic membrane, high in glucosaminglycan & similar to the lining of lacunae in cartilage and bone.

INTERTUBULAR DENTIN:

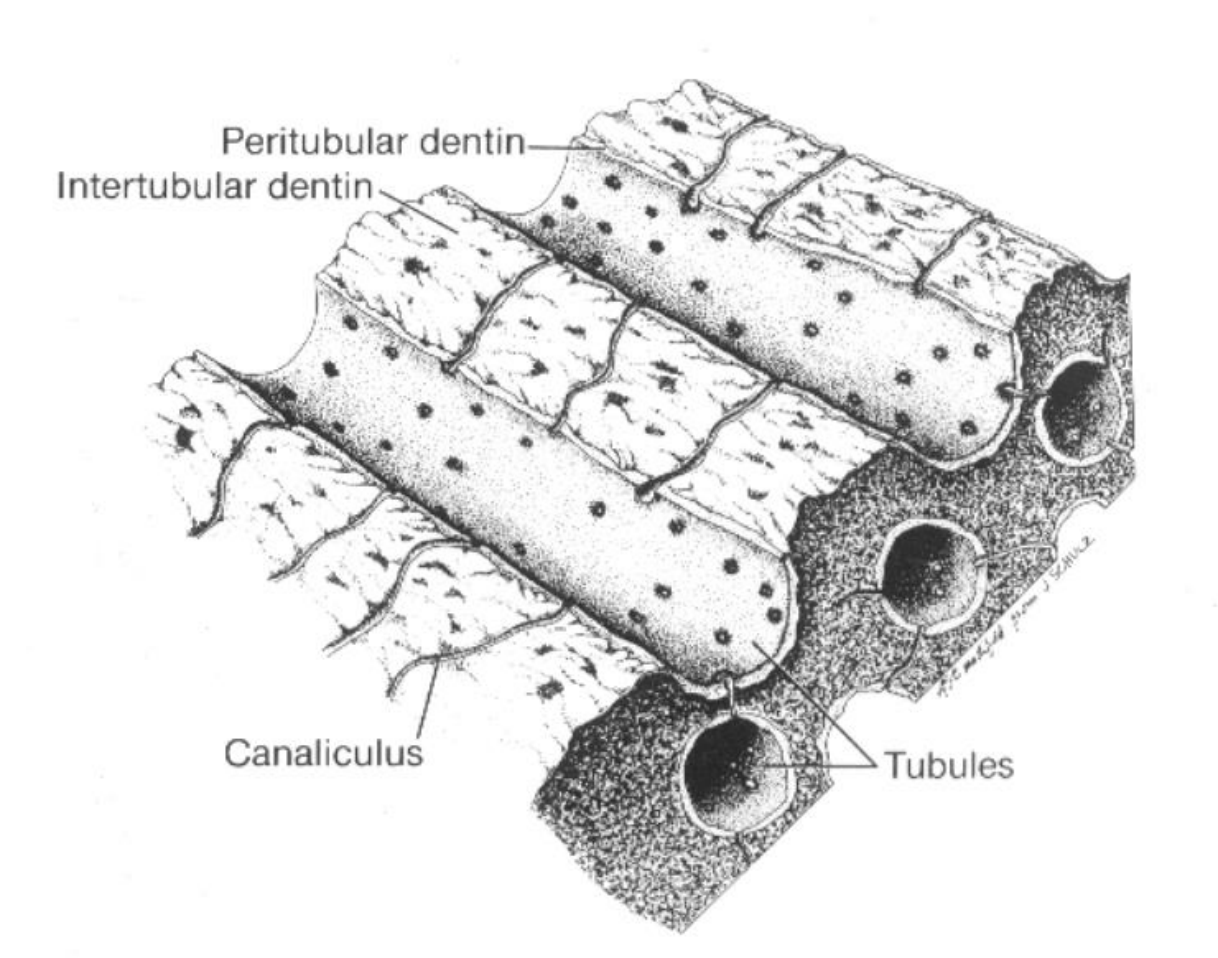
The main body of dentin is composed of intertubular dentin.

It is located between the dental tubules or more specifically, between the zones of peritubular dentin

One half of its organic matrix is collagen fibers, which are randomly oriented around the dentinal tubules.

The fibrils range from 0.5 to 0.2 um in diameter and exhibit cross banding at 64 nm intervals.

Hydroxyapatite crystals, 0.1 um in length, are formed along with fibers with their long axes oriented parallel to the collagen fibers.



Schematic presentation of dentinal tubules showing
Peritubular dentin
Intertubular dentin &
Canaliculi

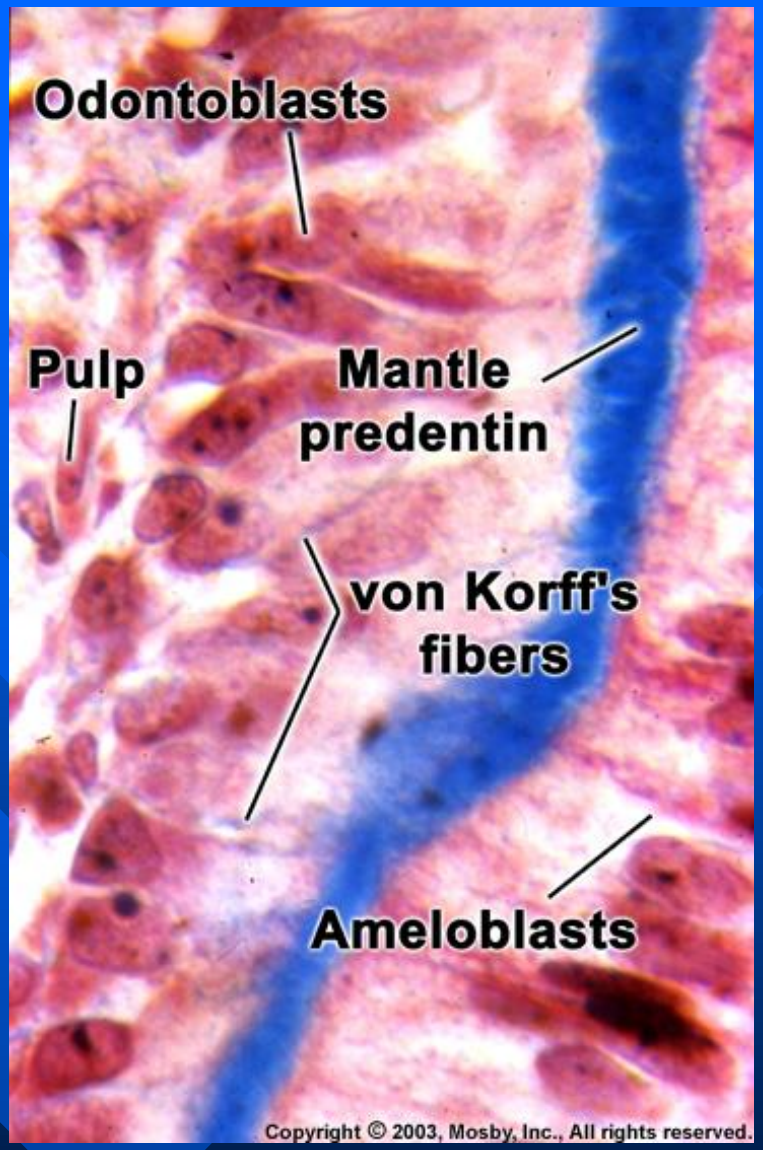
PREDENTIN:

It is the first formed dentin & is not mineralized.

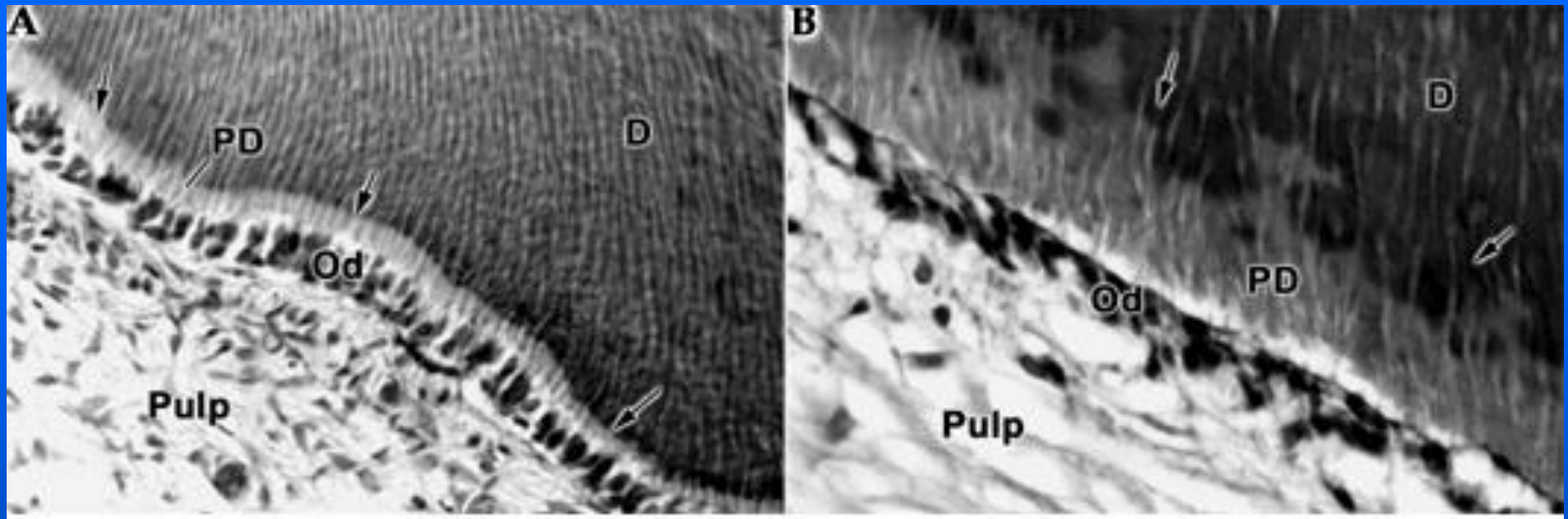
Located adjacent to the pulp tissue

2 to 6 um wide, depending on the activity of the odontoblast.

As the collagen fibers undergo mineralization at the predentin-dentin front, the predentin then becomes dentin and a new layer of predentin forms circumpulpally.



The diagram showing unmineralized **predentin**



Light photomicrographs of the predentin-dentin *(PD, D)* interface illustrating
(A) Linear and
(B) Globular mineralization fronts *(arrows).*
Od, Odontoblasts.

ODONTOBLAST PROCESS:

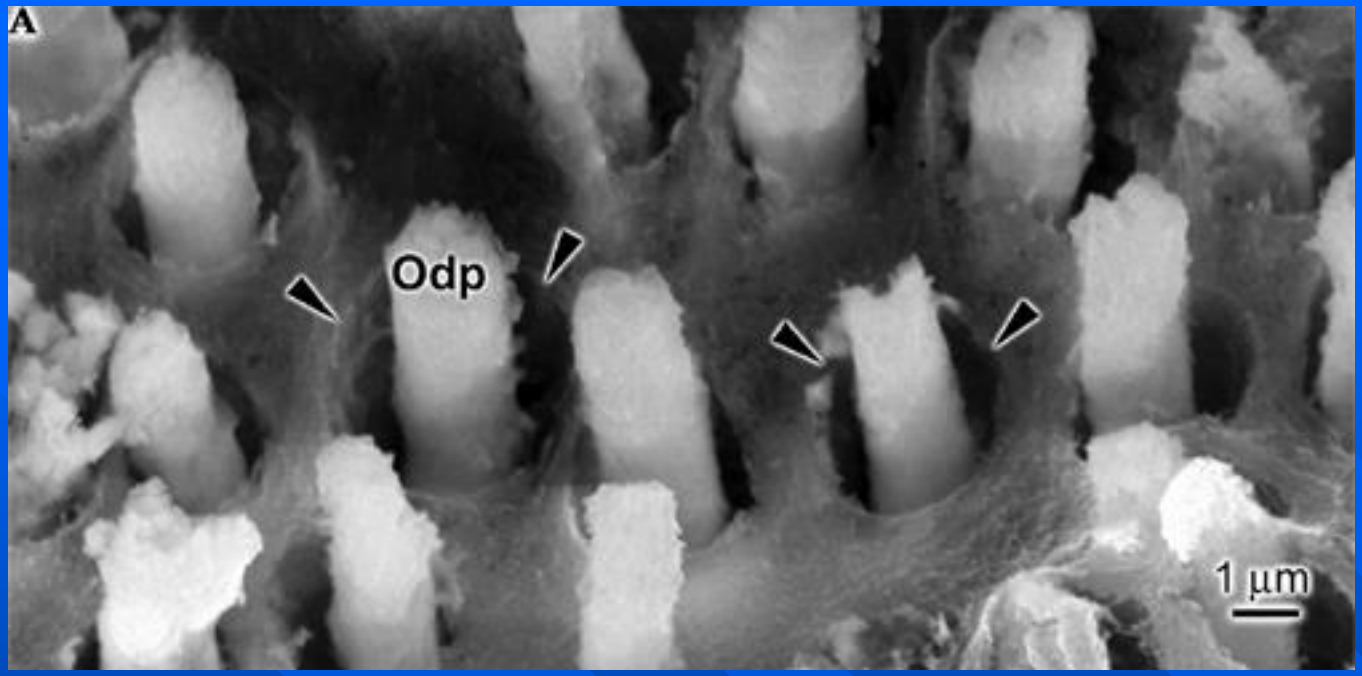
These are cytoplasmic extensions of the odontoblasts.

It is composed of

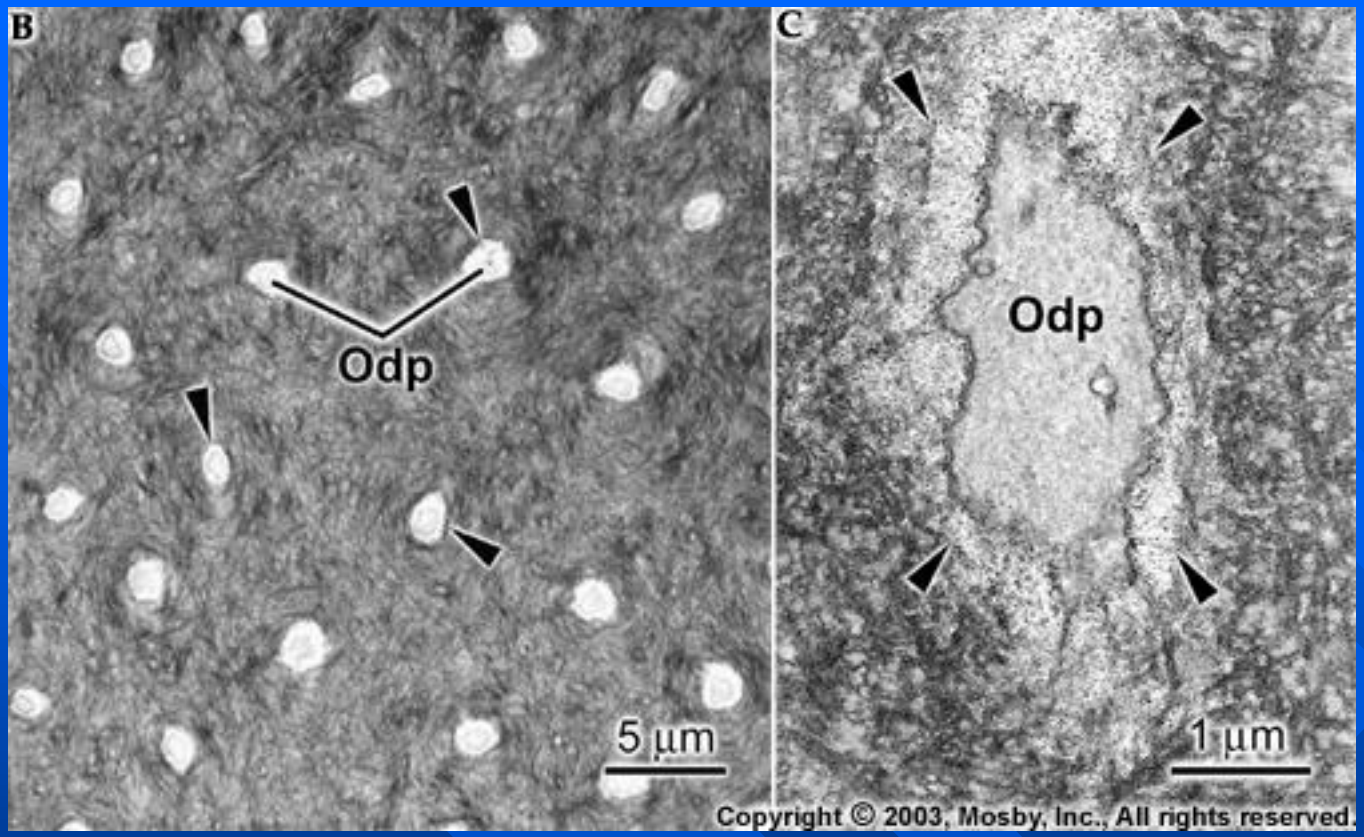
- Microtubules of 20 nm diameter.
- Small filaments 5 to 7.5 nm in diameter.
- Occasionally mitochondria, dense bodies resembling lysosomes, micro vesicles and coated vesicles that may open to the extra cellular space are also seen.

Odontoblasts reside in the peripheral pulp at the pulp-predentin border & their processes extend into the dentinal tubules.

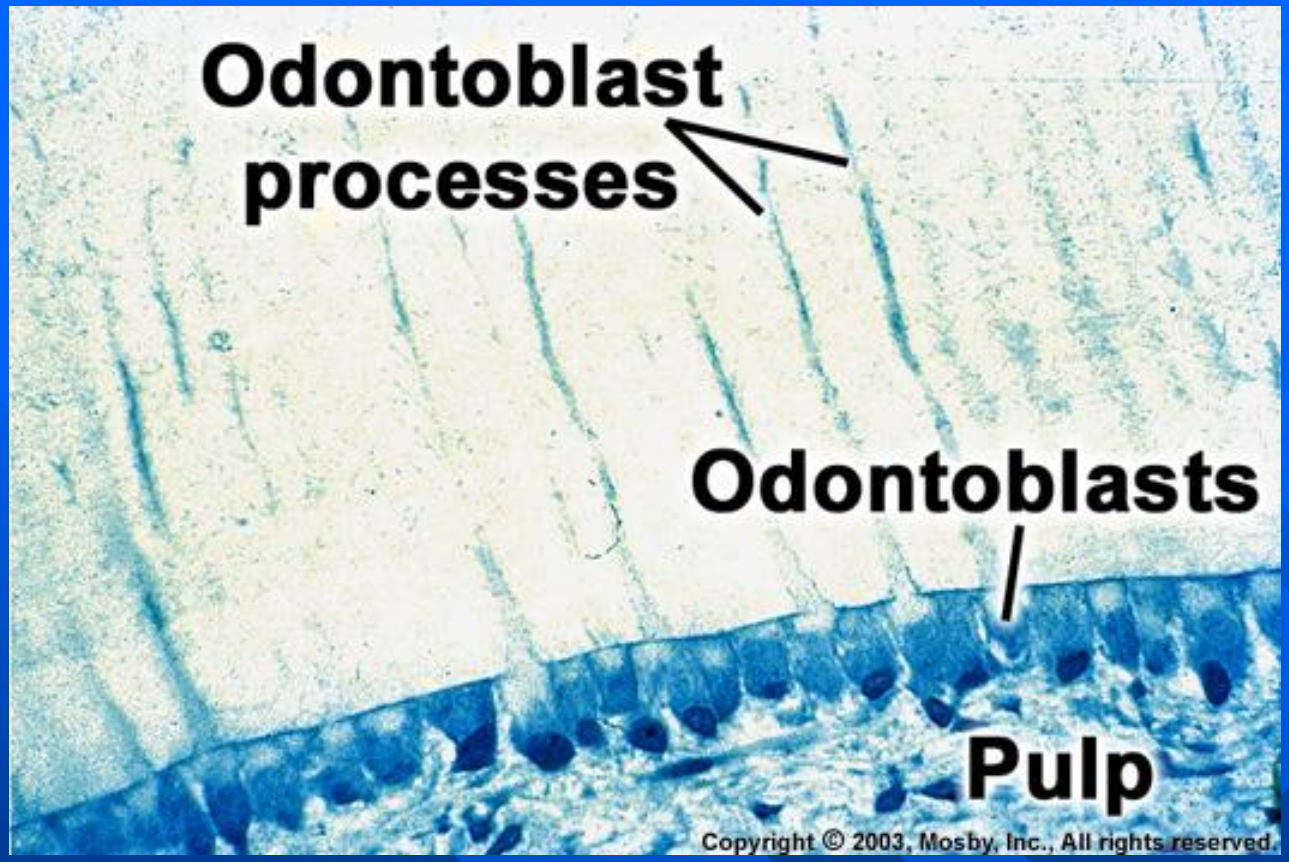
The processes are largest in diameter near the pulp (3-4 um) and taper to approximately 1 um further into the dentin.



Odontoblast processes *(Odp)* run in canaliculi called dentinal tubules (arrowheads). Images from scanning electron microscope



Odontoblast processes *(Odp)* run in canalicules called dentinal tubules (arrowheads). Images light microscope, and transmission electron microscope.



Odontoblasts have apical processes that remain in the matrix they form.

Odontoblast cell bodies are approximately 7 um I diameter and 40 um in length.

Odontoblast process extend to the DEJ.

It is appropriate to consider that some odontoblast processes traverse the thickness of dentin. In other areas a shortened process may be characteristic in tubules that are narrow or obliterated by mineral deposit.

PRIMARY DENTIN:

MANTLE DENTIN

The first formed dentin in the crowns underlying the DEJ.

It is thus the outer or most peripheral part of the primary dentin is about 20 um thick, it is thus area of initial dentin matrix formation

The fibrils formed in this zone are perpendicular to the DEJ and the organic matrix is composed of loosely packed coarse collagen fibrils.

CIRCUMPULPAL DENTIN

It forms the remaining primary dentin or bulk of the tooth.

It is the circumpalpal dentin that represents all of the dentin formed prior to root completion.

Collagen fibrils in this are much smaller in diameter (0.05 um) and are more closely packed together.

It contain slightly more mineral than mantle dentin.

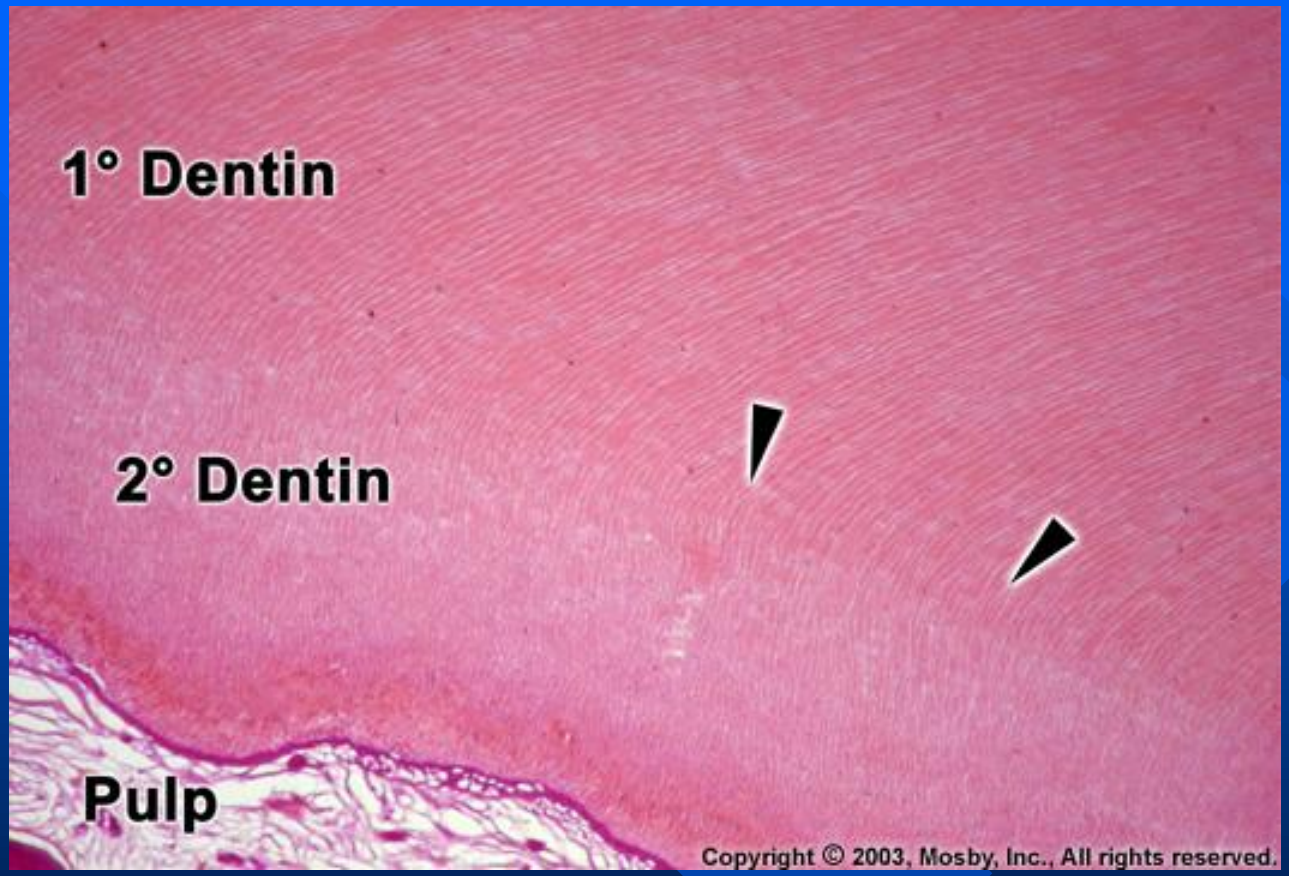
SECONDARY DENTIN:

It represents the continuing, but much slower, deposition of dentin by the odontoblasts after root formation has been completed.

It has an incremental pattern and a tubular structure that, though less regular, is for the most part continuous with that of the primary dentin.

The greater deposition of secondary dentin on the roof and floor of the pulp chamber leads to an asymmetric reduction in the size and shape of the chamber and of the pulp horns. These changes of the pulp are referred clinically as pulp recession.

There is usually a bend in the tubules where primary and secondary dentin interface.



The junction between primary and secondary dentin is characterized by a change in the direction of dentinal tubules (*arrowheads*).

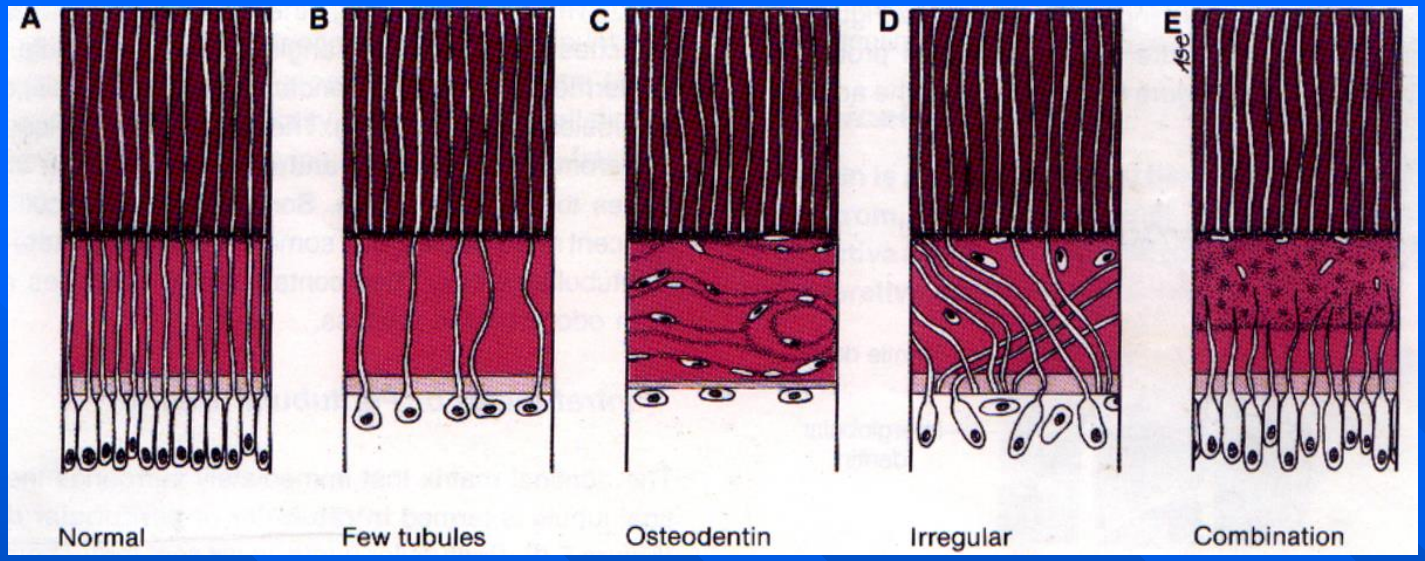
TERTIARY DENTIN

(REACTIVE, REPARATIVE OR IRREGULAR SECONDARY DENTN):

It is the dentin produced in reaction to various stimuli, such as attrition, caries, or a restorative dental procedure.

Unlike secondary dentin, which forms along the entire pulp dentin border, tertiary dentin is produced only by cells directly affected by the stimulus.

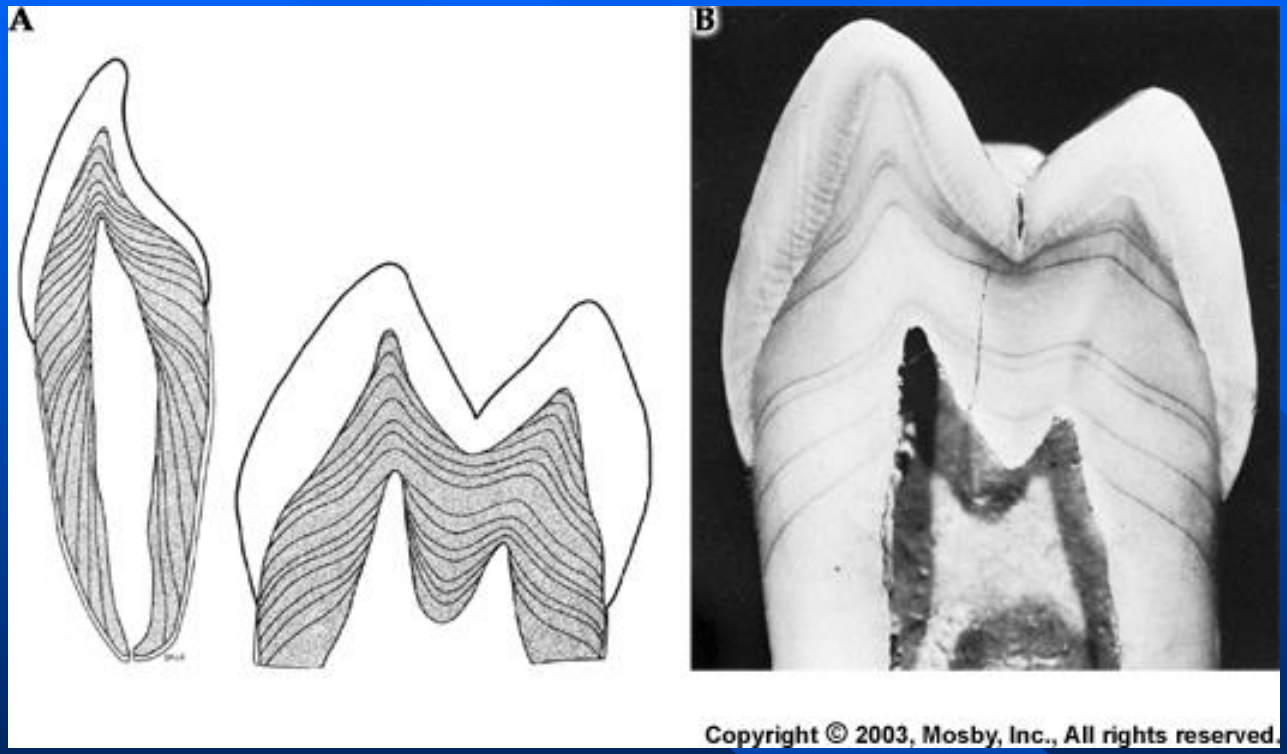
Tertiary dentin may have regular tubules continuous with those of secondary dentin, tubules sparse in number and irregularly arranged, or no tubules at all. (figure on next page)



A. Normal dentin
B. Reparative dentin(RD) showing fewer tubules
C. RD includes cells within its matrix. (osteodentin)
D. RD shows irregularly arranged tubules
E. RD is a combination of differrent types.

INCREMENTAL LINES:

They appear as fine lines or striations in dentin which run at right angles to dentinal tubules and correspond to the incremental lines in enamel or bone.



A, Pattern of incremental line deposition in dentin. **B,** Tooth section of a person who received tetracycline intermittently. The drug has been incorporated at successive dentin-forming fronts, mimicking incremental line patterns.

These lines reflect daily rhythmic, recurrent deposition of dentin matrix as well as a hesitation in the daily formative process.

The distance between lines varies from 4 to 8 um in the crown and much less in root.

Occasionally some of the incremental lines are accentuated because of disturbances in the matrix and mineralization process. Such are readily demonstrated in ground sections and are known as ***CONTOUR LINES OF OWEN*** which represents hypocalcified bands.

NEONATAL LINE:

In the deciduous teeth in the first permanent molars, where dentin is formed partly before and partly after birth, the prenatal and postnatal dentin are separated by an accentuated contour line. This is termed the NEONATAL LINE.

It is seen in enamel as well as dentin.

This line reflects the abrupt change in environment that occurs at birth.

It may be a zone of hypocalcification.

INTERGLOBULAR DENTIN:

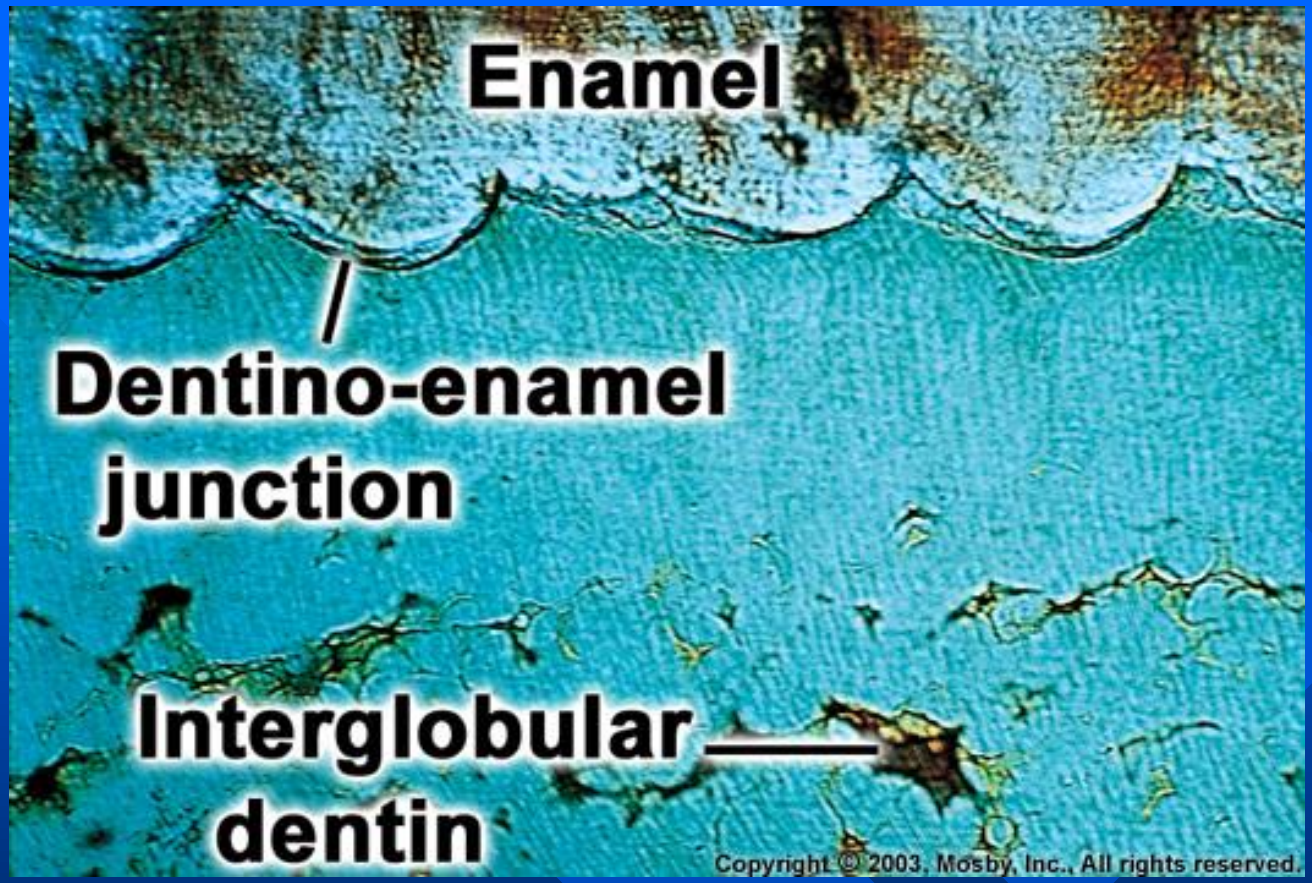
Sometimes mineralization of dentin begins in small globular mass that fail to fuse into a homogenous mass. This results in zones of hypomineraliztion between the globules these zones are known as interglobular dentin.

It forms in the crowns of teeth in the circumpulpal dentin just below the mantle dentin, and it follows the incremental pattern.

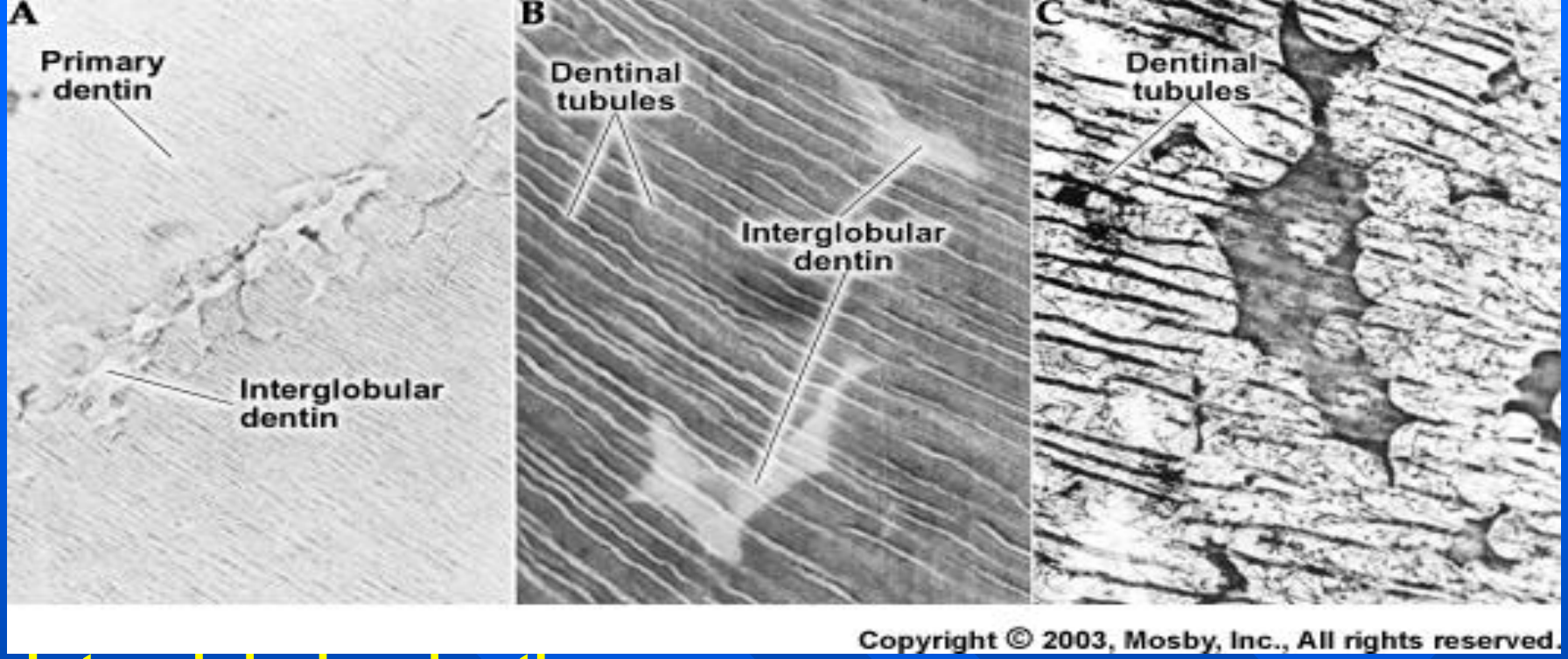
It is especially prevalent in human teeth in which there has been

- A deficiency of vitamin D.
- Exposure to high levels of fluoride…at the time of dentin formation.

Seen black in transmitted light.



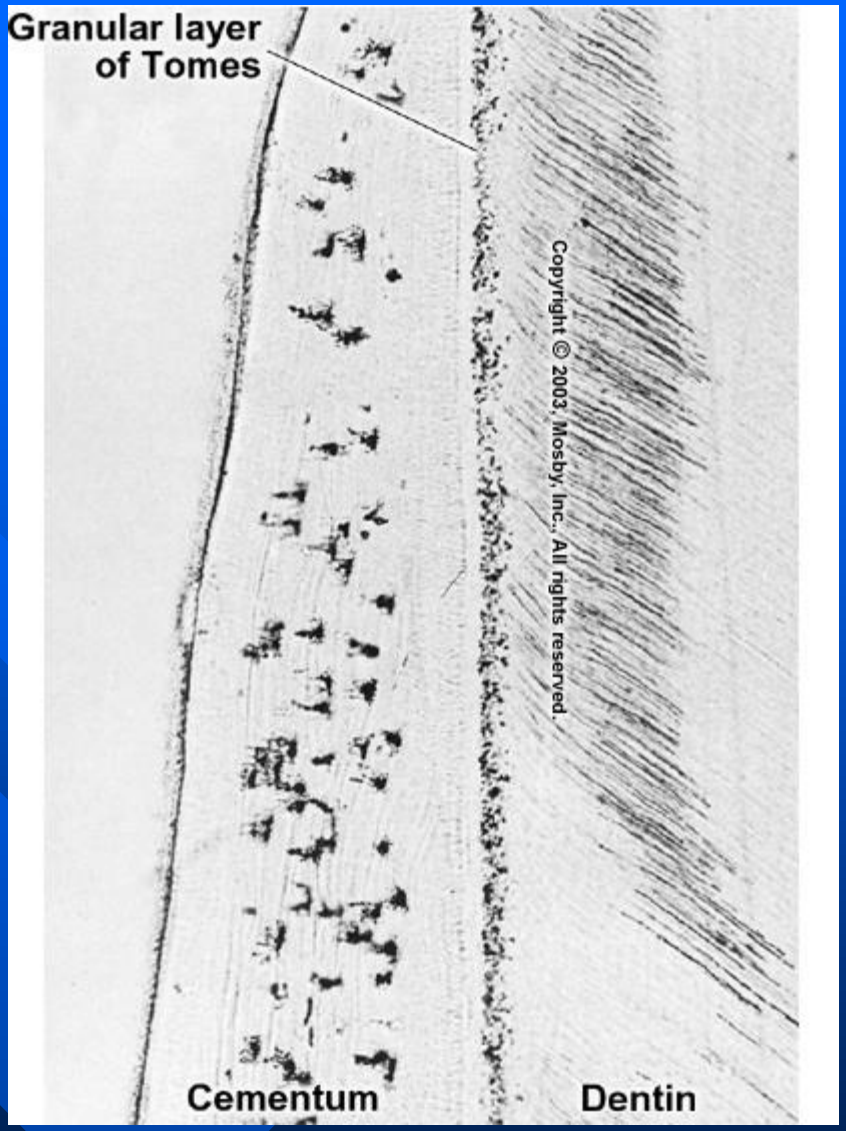
Interglobular dentin represents unmineralized matrix regions resulting from imperfect globular mineralization



Interglobular dentin. **A,** Ground section. **B,** Demineralized section stained with hematoxylin-eosin. **C,** Demineralized section stained with silver nitrate. The spherical borders of the interglobular areas indicate the failure of calcospherite fusion. In **B** the staining of nonmineralized matrix is lighter and in **C** is darker. Dentinal tubules pass through the interglobular dentin, but no peritubular dentin is present in these areas. Silver nitrate staining reveals numerous smaller tubules into which run the branches of the odontoblast process.

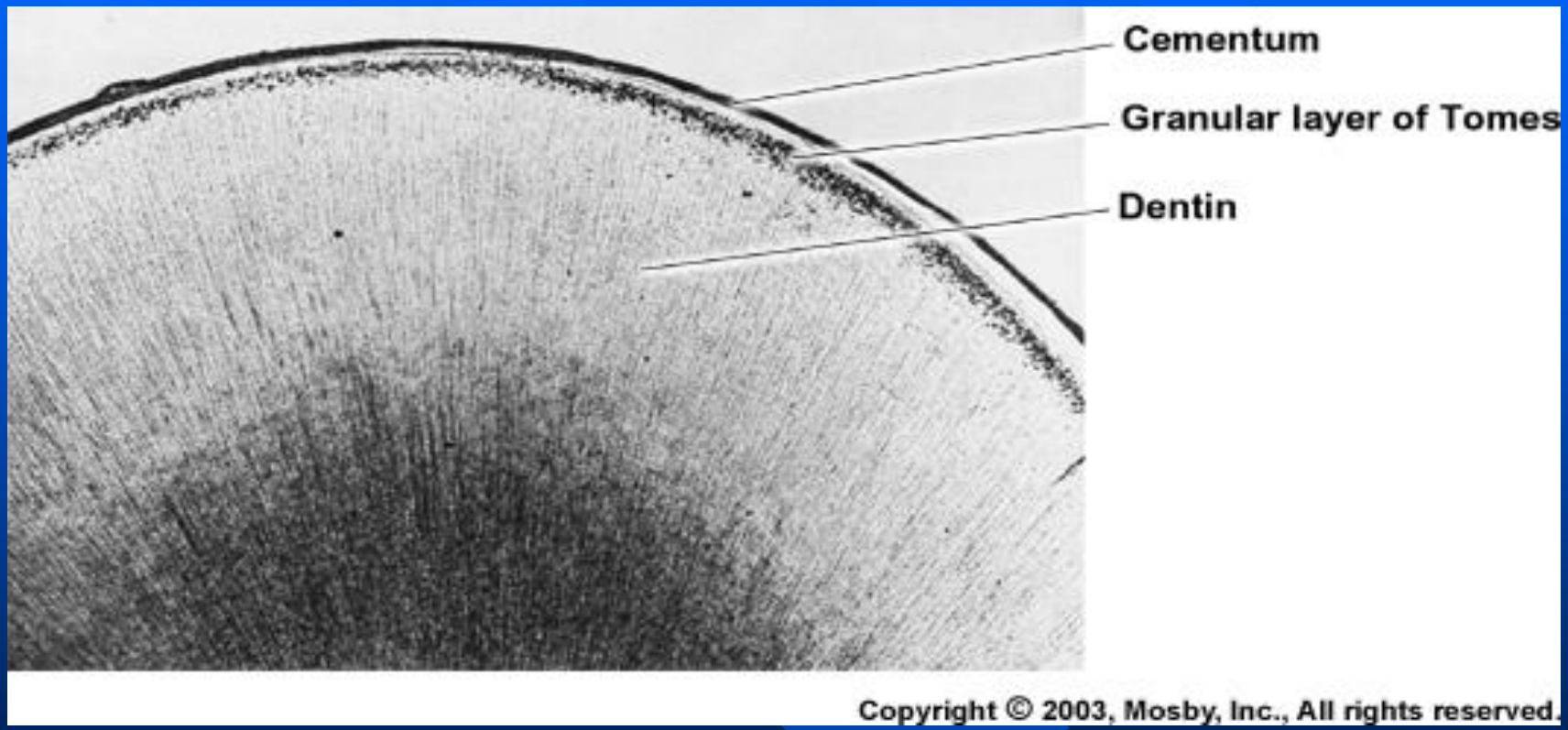
GRANULAR LAYER:

When ground sections of the root dentin are visualized in transmitted light, there is a zone adjacent to the cementum that appears granular which is known as **granular layer (Tome's).**



Longitudinal ground section of the granular layer of Tomes

This zone increases slightly in amount from the CEJ to the root apex and is believed to be caused by a ***coalescing and lopping*** of the terminal portions of the dentinal tubules.



Ground section across the root of a tooth. The granular layer of Tomes is visible just beneath the cementum

INNERVATION OF DENTIN:

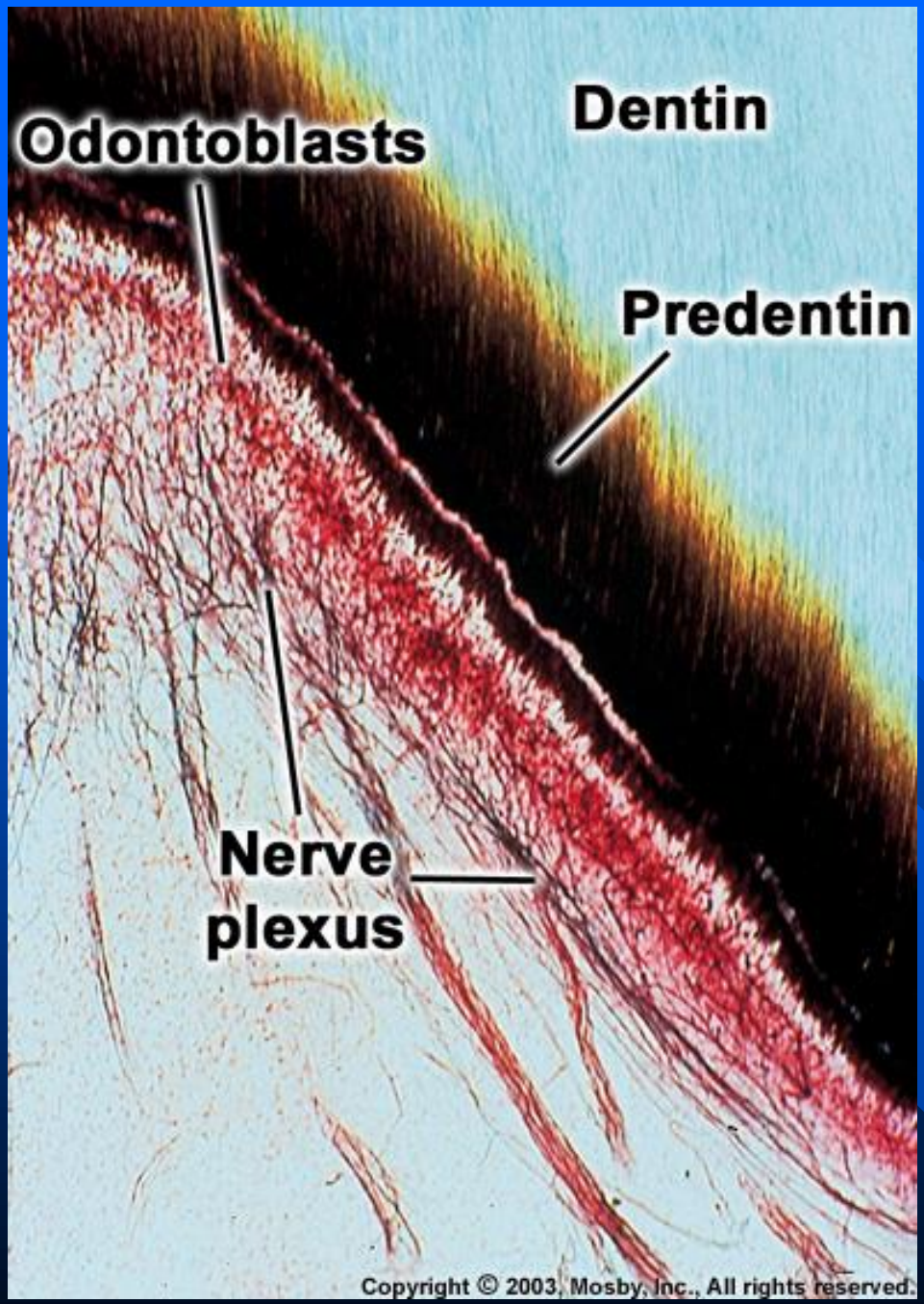
Intertubular nerves:

In the predentin and inner dentin no farther than 100 to 150 um from pulp.
Most of these located in tubules in the coronal zone, specifically in the pulp horns.

The nerves and their terminal are found in close association with the odontoblast process within the tubule

The nerve ending interdigitate with the odontoblast process, indicating an intimate relationship to this cell it is believed that most of these are terminal processes of the myelinated nerve fibers of the dental pulp.

The primary afferent somatosensory nerves of the dentin and pulp project to the main sensory nucleus of the midbrain.



Tooth section stained to demonstrate the nerves of the pulp. Note the plexus beneath the odontoblast layer.

THEORIES OF PAIN TRANSMISSION THROUGH DENTIN

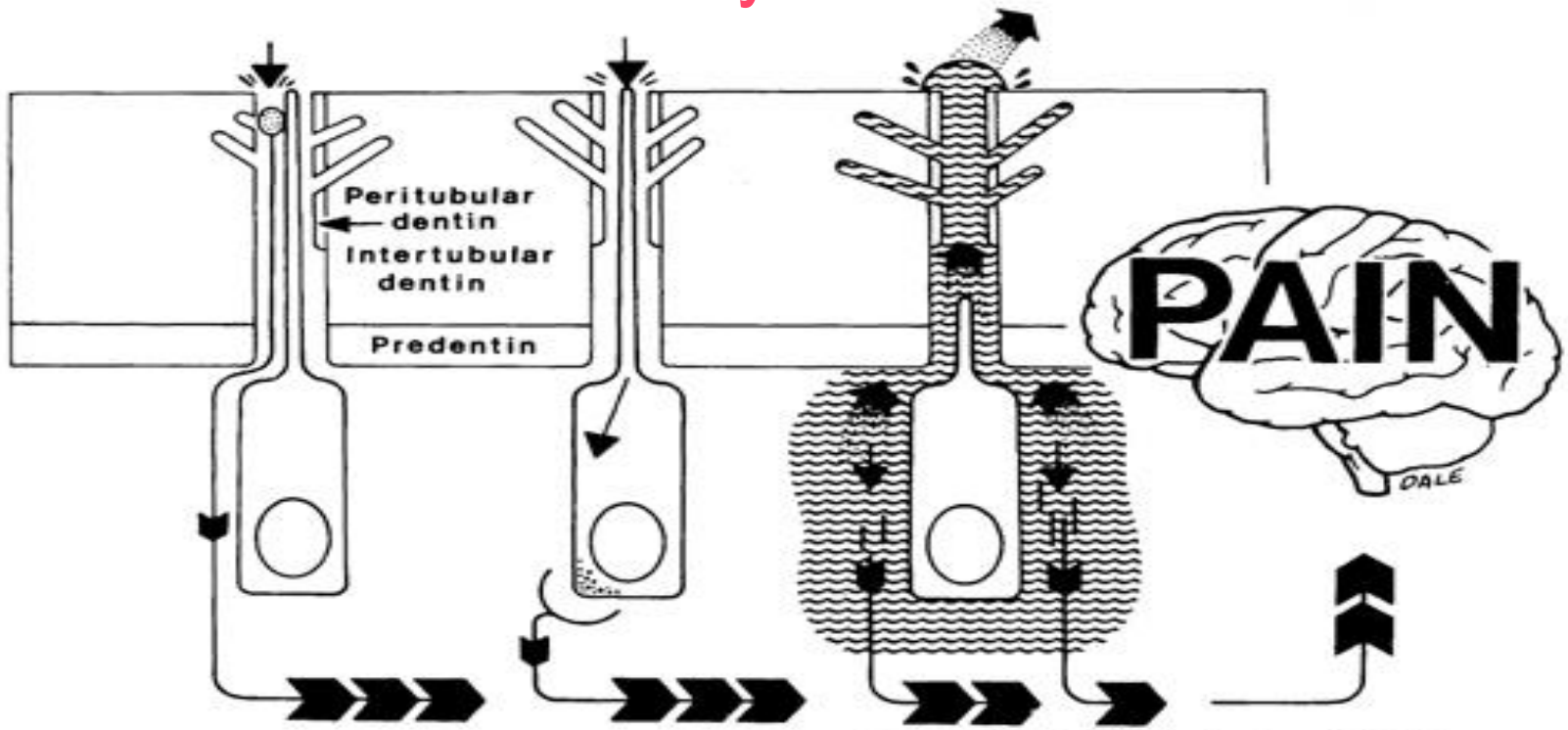
There are 3 basic theories:

Direct neural stimulation , meaning that stimuli in some manner as yet unknown, reach the nerve ending in the inner dentin.

Hydrodynamic theory. Various stimuli such as heat, cold, airblast desiccation, or mechanical pressure affect fluid movement in the dentinal tubules. This fluid movement, either inward or outward stimulates the pain mechanism in the tubules by mechanical disturbance of the nerves closely associated with the odontoblast and its process.

Thus, these ending may act as mechanoreceptors as they are affected by mechanical displacement of the tubular fluid.

Theories of dentin sensitivity:



A suggests that the dentin is innervated directly. (Direct neural stimulation)

B suggests that the odontoblast acts as a receptor. (Transduction)

C suggests that the receptors are in the pulp and are stimulated by fluid movement through the tubules.(Hydrodynamic theory)

Transduction theory:

It presumes that odontoblast process is the primary structure excited by the stimulus and that the impulse is transmitted to the nerve ending in the inner dentin.

This is not a popular theory since there are no neurotransmitter vesicle in the odontoblast process to facilitate the synapse.

AGE & FUNCTIONAL CHANGES

DEAD TRACTS:

Loss of odontoblast processes may also occur in teeth containing vital pulp as a result of caries, attrition, abrasion, cavity preparation or erosion.

Where reparative dentin seals dentinal tubules at their pulpal ends, dentinal tubules fill with fluid or gaseous substances.

In ground sections such groups of tubules may entrap air and appear black in transmitted and white in reflected light. Dentin areas characterized by degenerated odontoblast processes give rise to dead tracts.

A B

Dead tracts in a ground section of dentin.

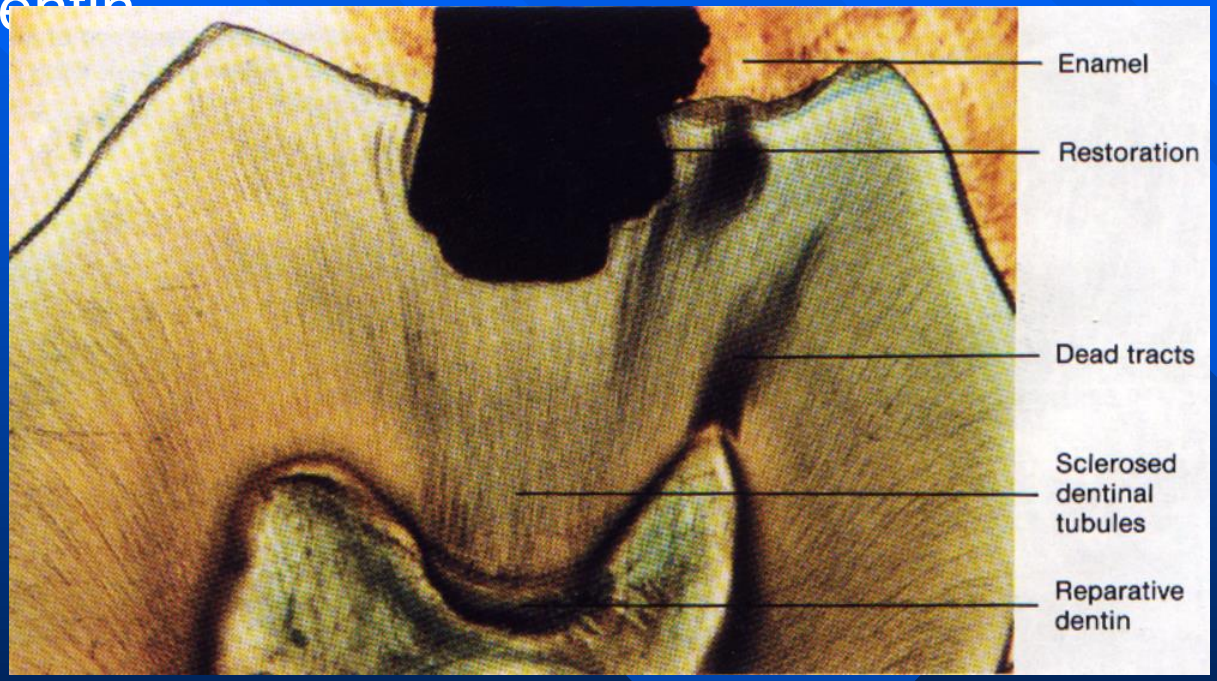
A, Under incident illumination the tracts appear white because light is reflected.

B, Under transmitted illumination the tracts appear dark because air in them refracts the light.

Significance:

These areas demonstrate decreased sensitivity and appear to a greater extent in older teeth.

Dead tracts are probably the initial step in the formation of sclerotic dentin.



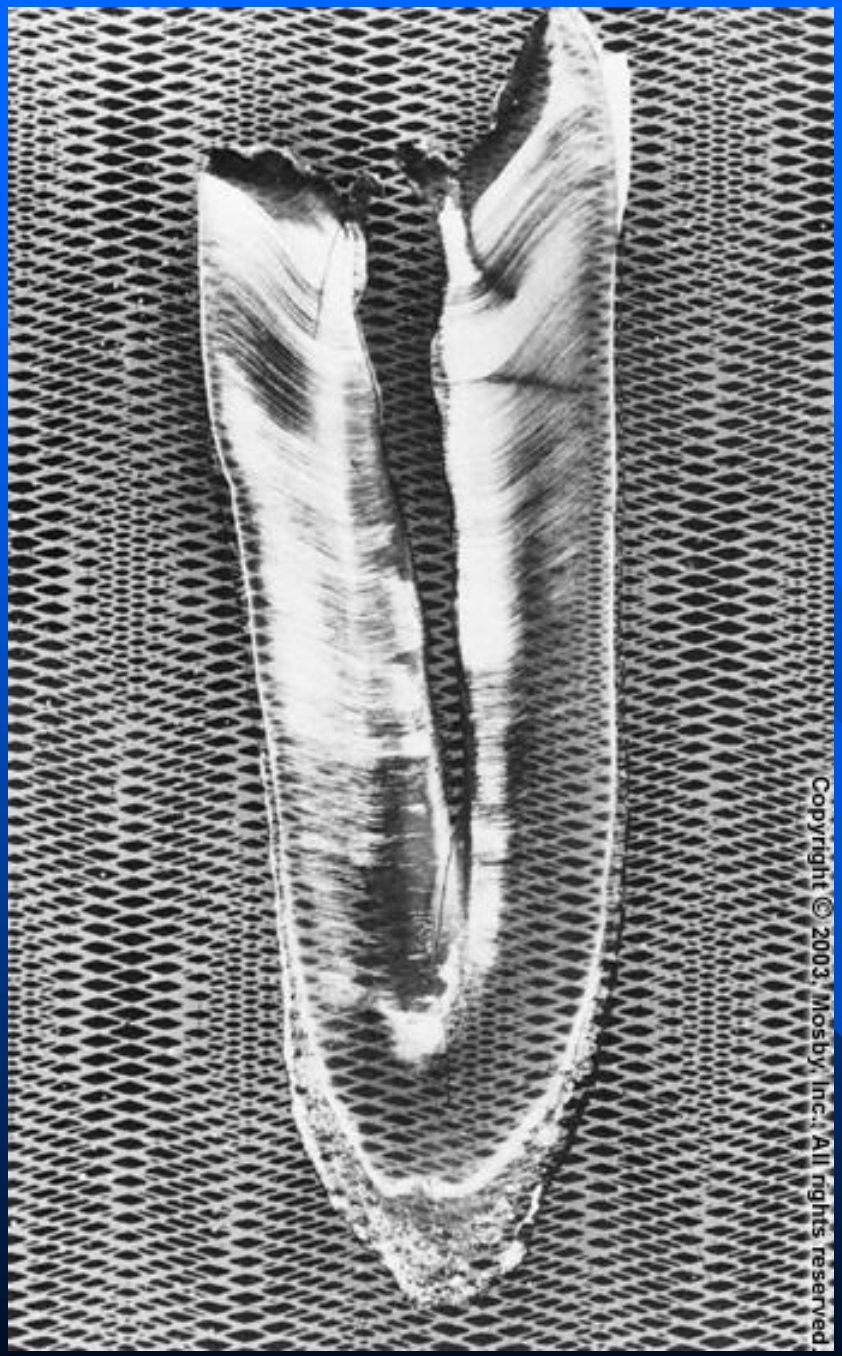
Dead tracts or open tubules underlie a restoration and are often associated with sclerosed dentinal tubules. (Next page)

SCLEROTIC OR TRANSPARENT DENTIN:

Stimuli not only induce additional formation of reparative dentin but also lead to protective changes in the dentin itself.

In cases of extensive abrasion, erosion, caries or operative procedures sufficient stimuli are generated to cause collagen fibers and appetite crystals to begin appearing in the dentinal tubules. Gradually, the tubule lumen is obliterated with mineral, which appears very much like the peritubular dentin. This is called **sclerotic dentin**.

The refractive indices of dentin in which the tubules are occluded are equalized, and such areas become transparent.



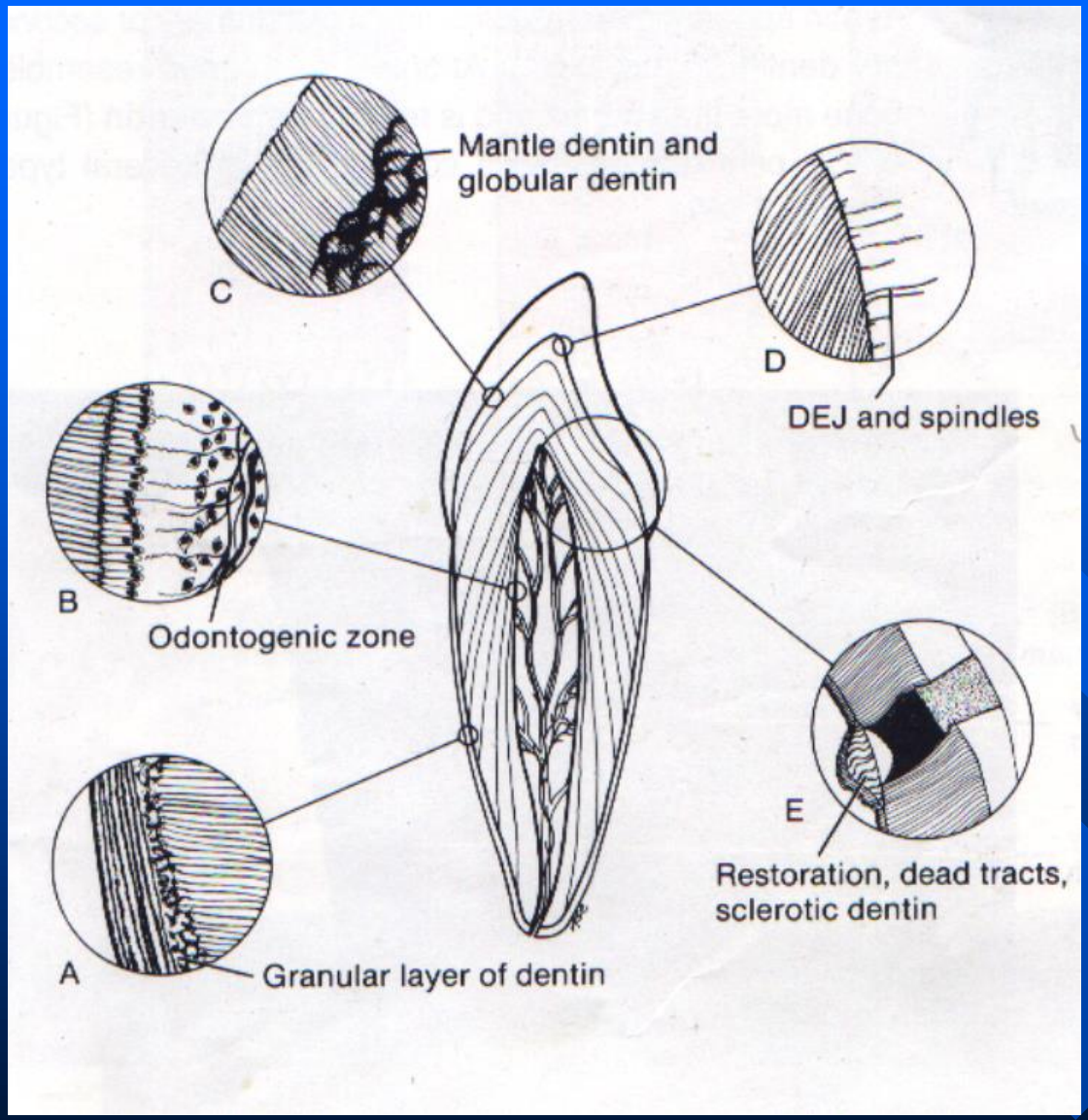
Ground section, approximately 100 μm thick, of an old tooth. The section has been placed over a pattern, which can be seen through the apical translucent sclerotic dentin.

SCLEROTIC DENTIN(CONTD.):

It is observed in

- Teeth of elderly people, especially in the roots.
- It may be found under slowly progressing caries.

Mineral density is greater in this area of dentin



SUMMARY:
The diagram showing parts of dentin with their respected sites where they are found

DENTINOGENESIS

- Dentinogenesis begins at the cusps tips after the odontoblasts have differentiated and begin collagen production.
- As the odontoblast differentiate they change from an ovoid to a columnar shape, and their nuclei become basally oriented at this early stage of development.
- One or several processes arise from the apical end of the cell in contact with the basal lamina.
- The length of odontoblast then increases to approximately 40 micrometer although its width remains constant (7 micrometer).

•Proline appears in the rough surface endoplasmic reticulum and Golgi apparatus. The proline then migrates into the cell process in dense granules and is emptied into the extra cellular collagenous matrix of the predentin.

•As the cell recedes it leaves behind a single extension and the the several initial processes join into one, which becomes enclosed in a tubule.

•As the matrix formation continues, the odontoblast process lengthens, as does the dentinal tubule.

•Intially daily increments of app. 4micrometer of dentin are formed. This continues until the crown is formed and the teeth erupt and move into occlusion.

•After this time dentin production slows to about 1micro meter per day.

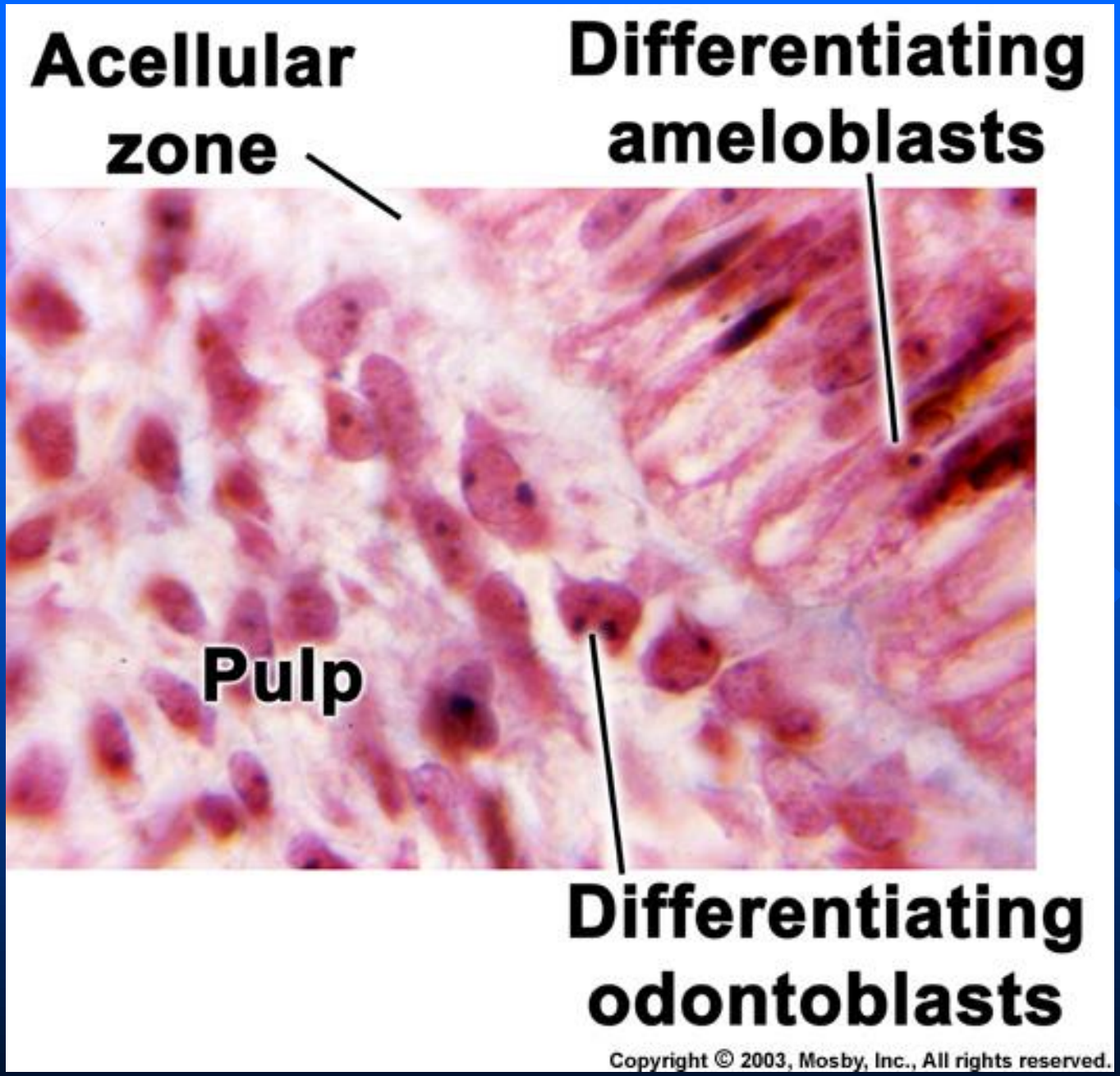
•After root development is complete, dentin formation may decrease further, although reparative dentin may form at a rate of 4 micrometer per day for several months after a tooth is restored.

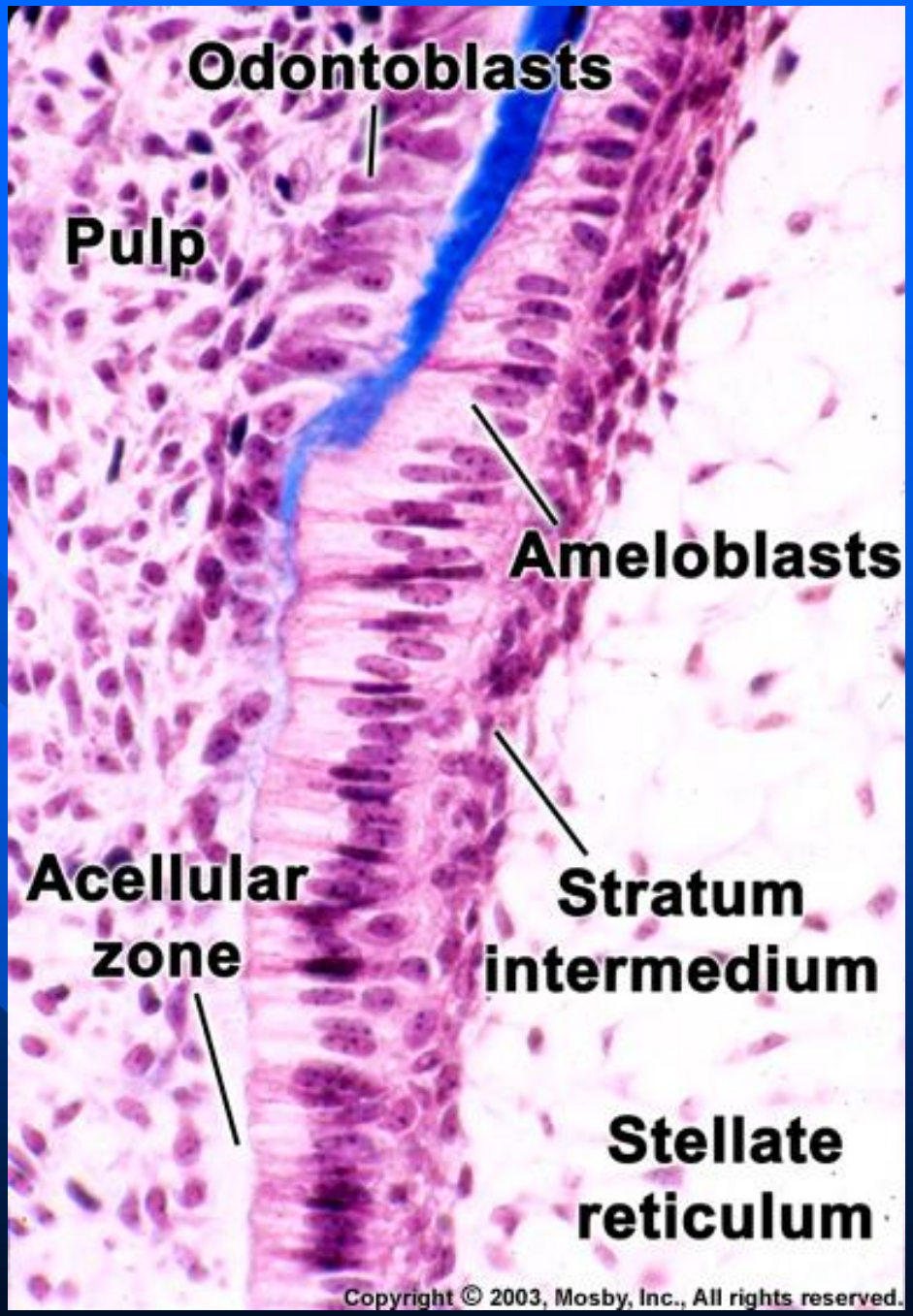
•Dentinogensis is a two phase sequence in that collagen matrix is first formed and then calcified. As each increment of predentin is formed along the pulp border, it remains a day before it is calcified and the next increment of predentin forms.

•Korff's fibers have been described as the initial dentin deposition along the cusp tips.

•Consequently, all predentin is formed in the apical end of the cell and along the forming tubule wall. The finding of formation of collagen fibers in the immediate vicinity of the apical ends of the cells is in agreement with the general concept of collagen synthesis in connective tissue and bone.

• The odontoblasts secrete both collagen and the intercollagen substance proteoglycans.




Odontoblasts
Pulp
Ameloblasts
Acellular zone
Stratum intermedium
Stellate reticulum
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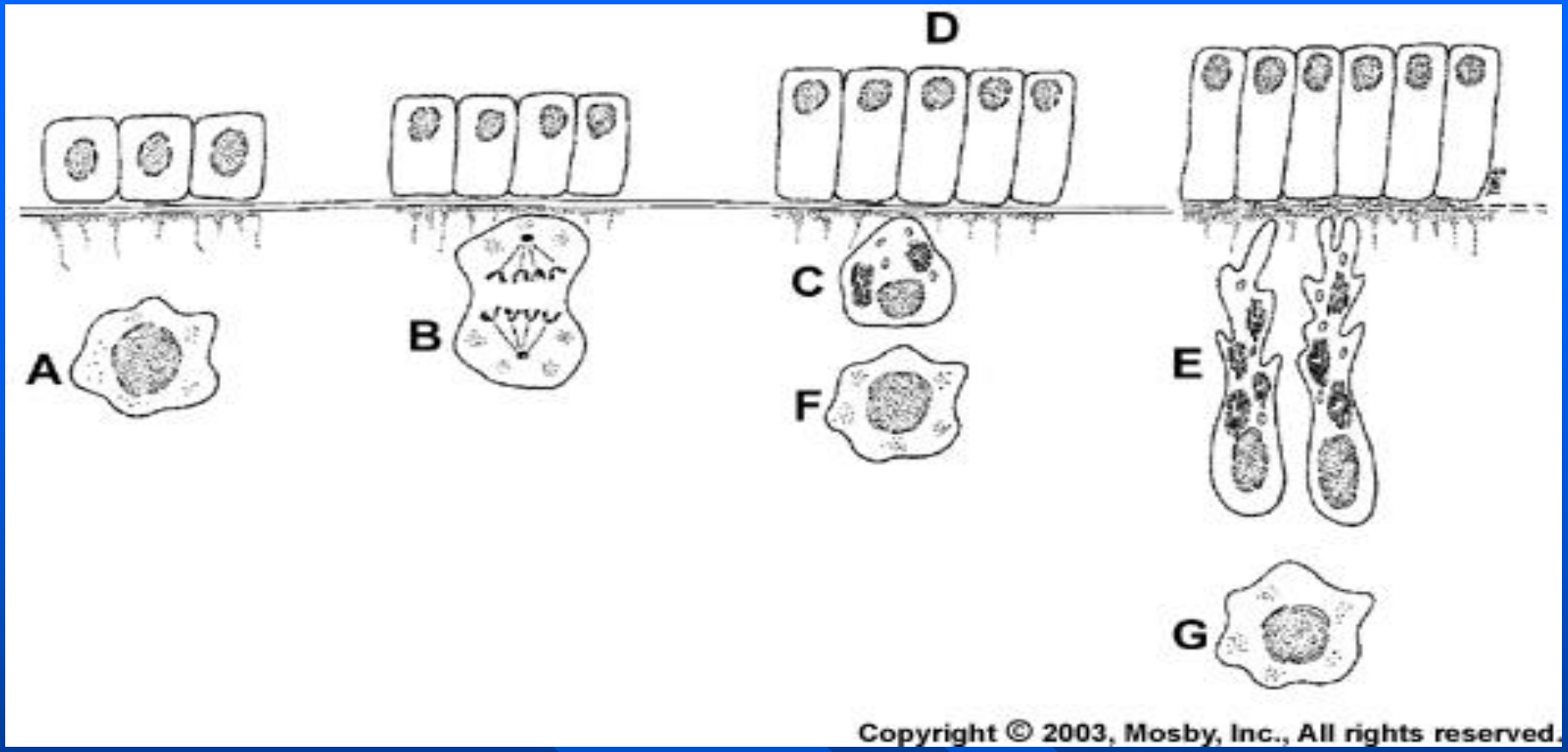
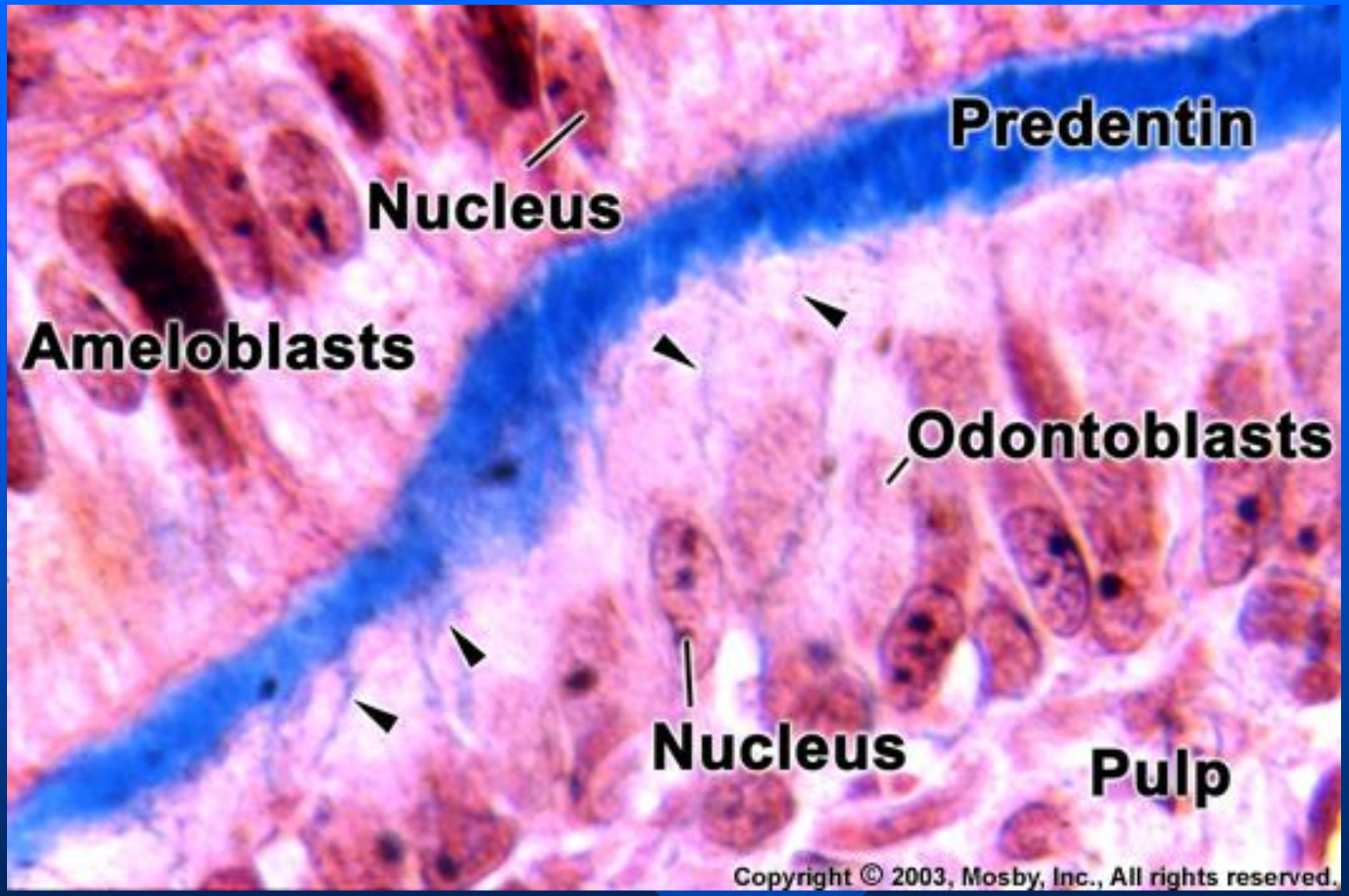
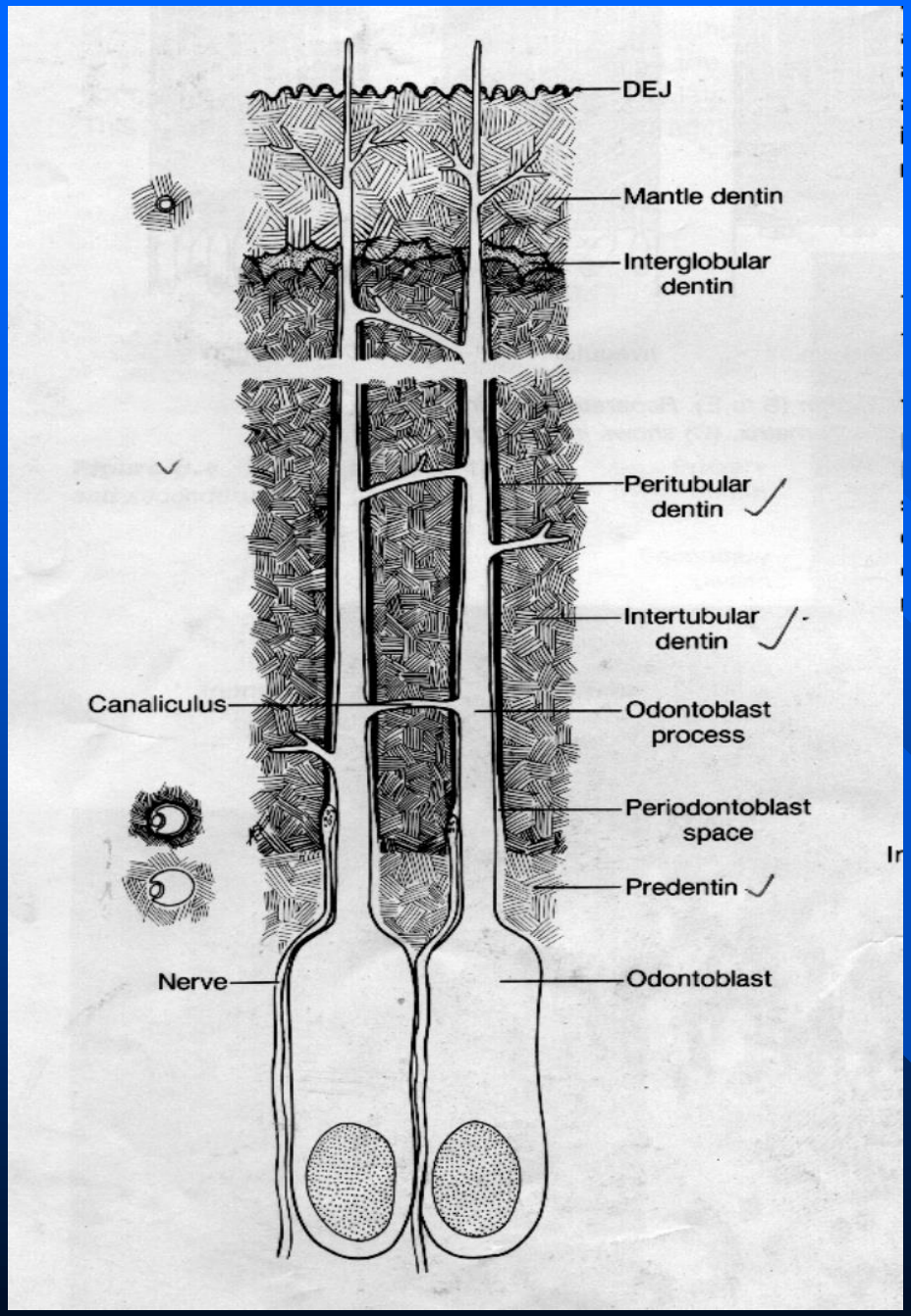


Undifferentiated mesenchymal cell (UMC) (A)
UMC with its mitotic spindles perpendicular to basement membrane (B)
Under influence of epithelial cell, D, a daughter cell (C) differentiates into Odontoblasts (E)
Another daughter cell, F, persists as subodontoblastic layer (G)



PREDENTIN



The diagram showing …
Odontoblasts & its process
Mantle dentin,
Interglobular dentin
Peritubular dentin,
Predentin,
Canaliculi etc.

MINERALIZATION

- The mineralization sequence in dentin appears to be as follows:
- The earliest crystal deposition is in the form of very fine plates of hydroxyapatite on the surfaces of the collagen fibrils and in the ground substance.
- Subsequently, crystals are laid down within the fibrils themselves.

- The crystals assosiacted with the collagen fibrils are arragned in an orderly fashion, with their long axes paralleling the fibril axes, and in rows conforming to the 64 nm (640 A) striation pattern.

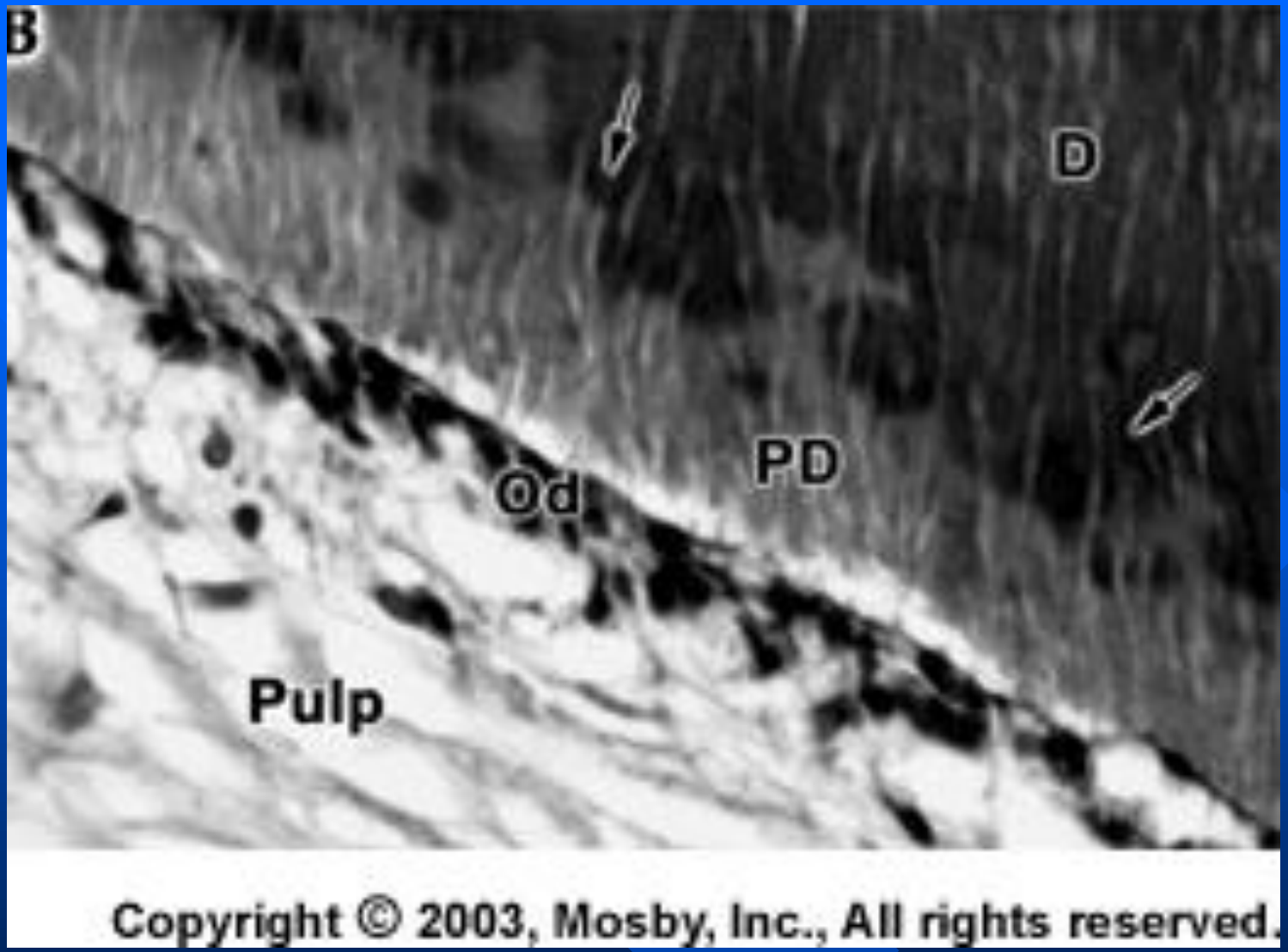
- Within the globular islands of mineralization, crystal deposition appears to take place radially from common centers, in a so-called **spherulite** form.

- The general calcification process is gradual, but the peritubular region becomes highly mineralized at a very early stage.

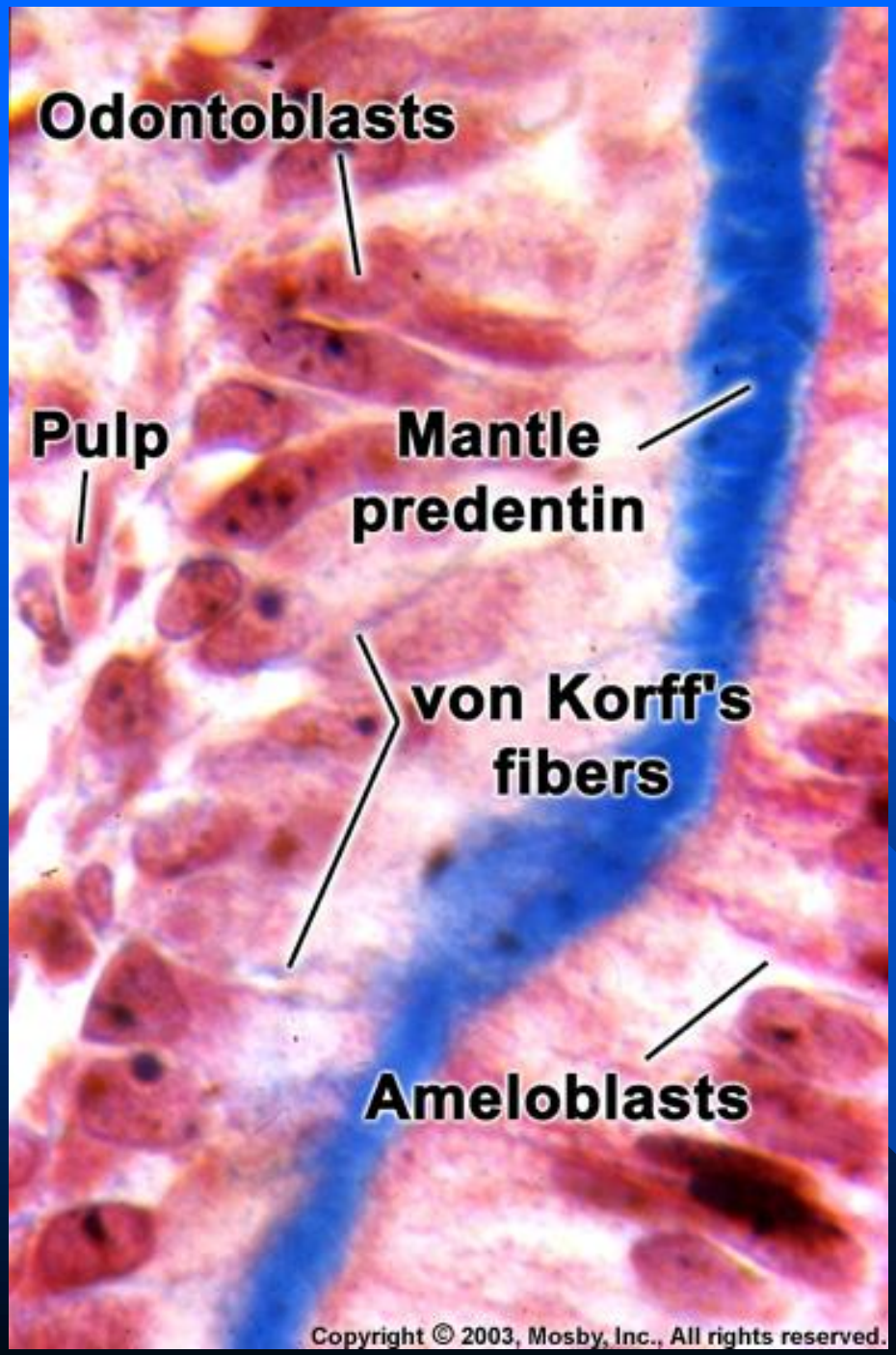
- Although there is obviously some crystal growth as dentin matures, the ultimate crystal size remains small, about 3 nm (30A) in thickness and 100 nm (1000A) in length.

- The apatite crystals of dentin resemble those found in bone and cementum. They are 300 times smaller than those formed in enamel.

- It is interesting that two cells so closely allied at the dentinoenamel junction produce crystals of such a size difference but at the same time produce chemically the same hydroxyapatite crystals. Calcospherite mineraliztion is seen occasionally along the pulp-predentin-forming front.



Globular mineralization at predentin dentin front (arrows)

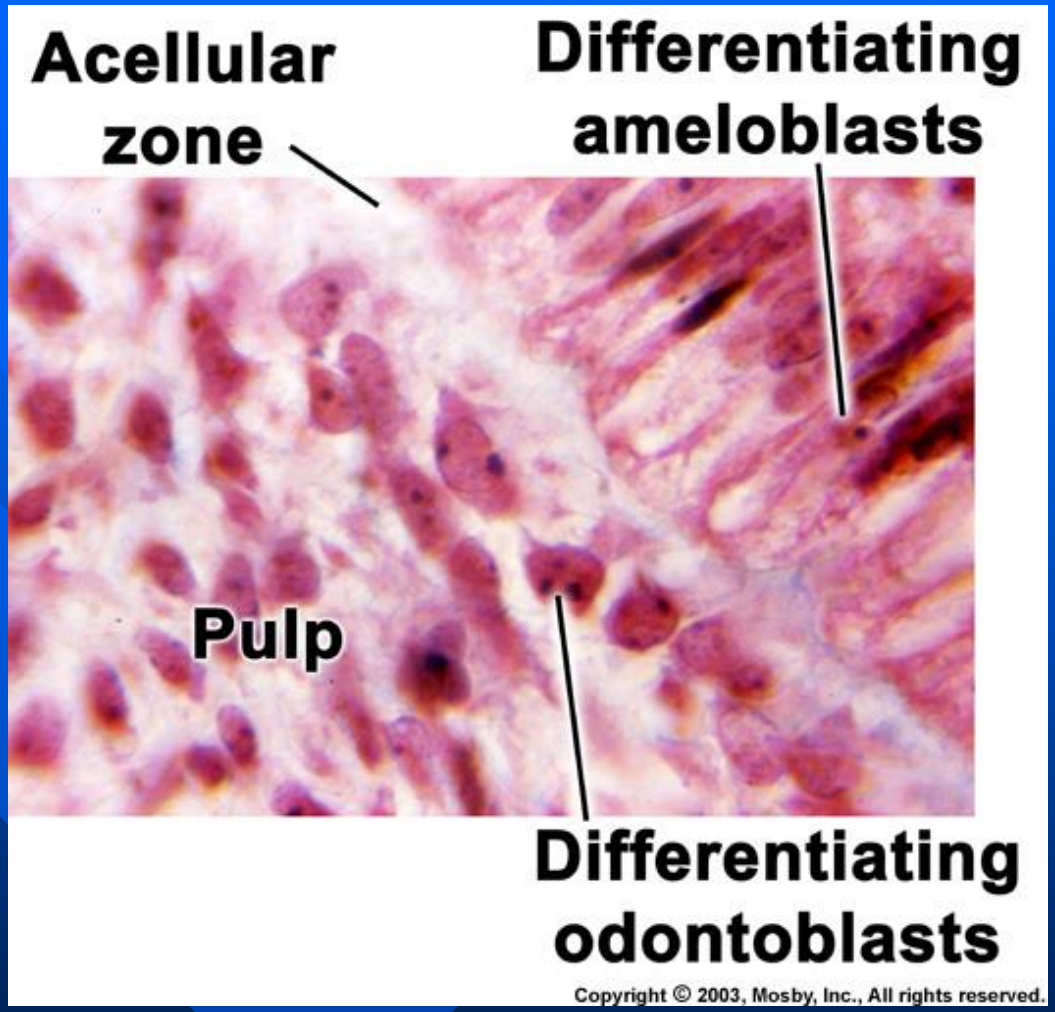


Von korff's fibers during dentinogenesis

DENTINOGENESIS:

Before dentinogenesis begins, the cells of the internal dental epithelium are short and columnar, rapidly dividing to accommodate growth of the tooth germ, and supported by a basement lamina that separates the epithelium from the dental papilla.

The dental papillary cells at this time are separated from the internal dental epithelium by an **acellular zone** and are small and undifferentiated with a central nucleus and sparse cytoplasm containing few cyytoplasmic organelles dispersed in a relatively structureless ground substance.



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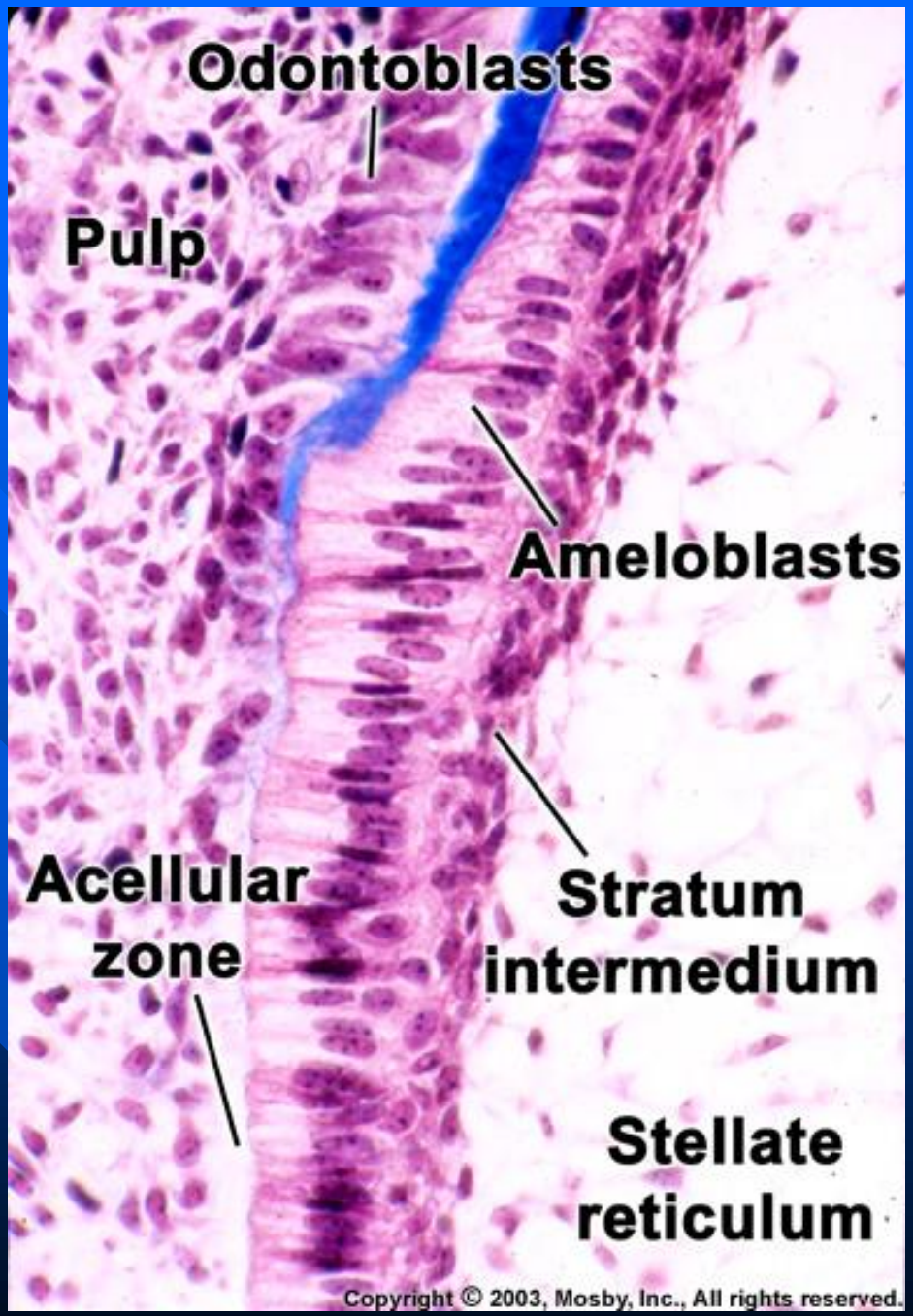


Cell division then ceases in the cells of the internal dental epithelium, their shape changes from short cuboidal to tall columnar, and their cell nuclei migrate toward the pole of the cell away fro the dental papilla.(reversal of functional polarity)

Almost immediately after these changes take place within the internal dental epithelium, changes also occur in the adjacent dental papilla.

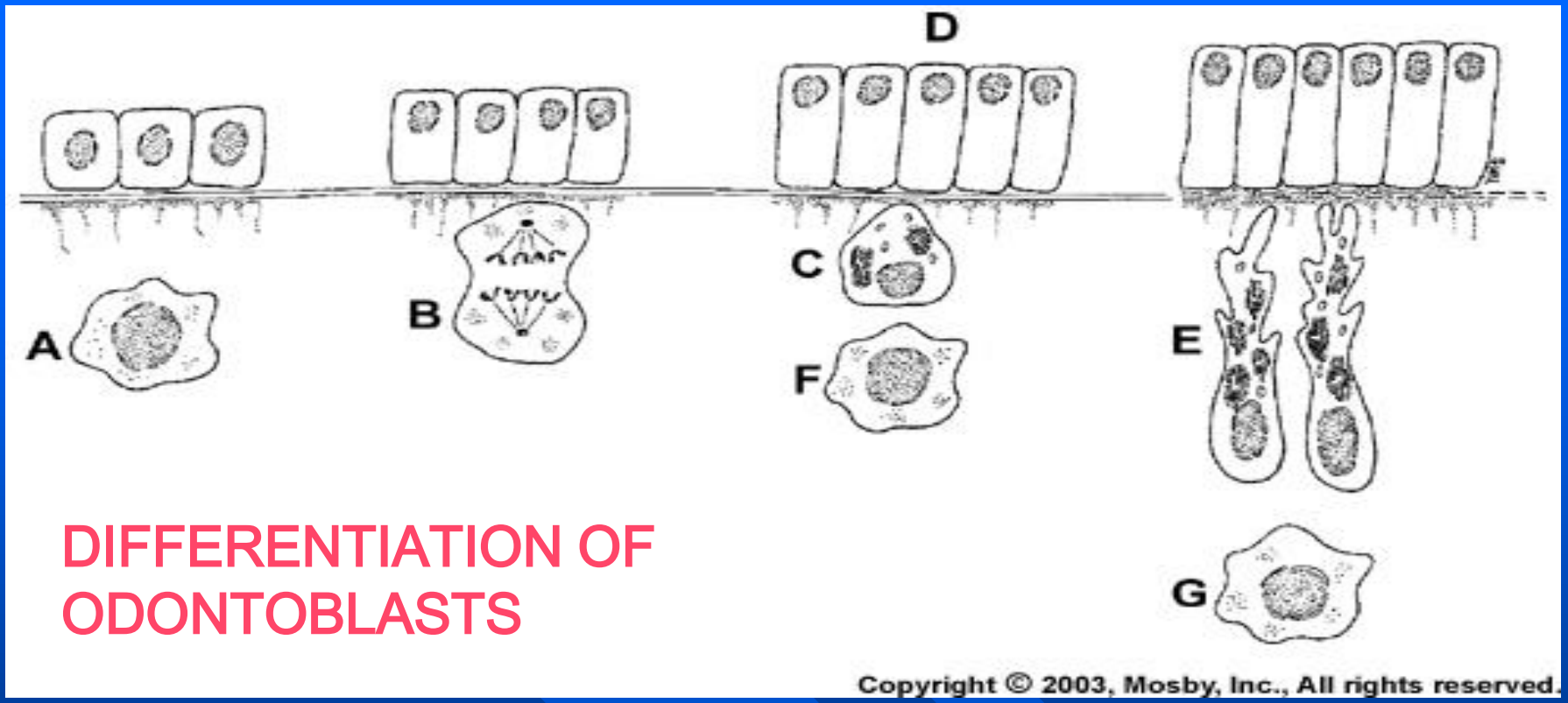
The ectomesenchymal cells adjoining the acellular zone rapidly enlarge to become, first, preodontoblasts, & odontoblast as following changes occur:

- Their cytoplasm increases in volume
- Increasing amount of rough endoplasmic reticulum and golgi complexes.
- Nuclei positioned away from the internal dental epithelium
- Elimination of the acellular zone because of increase in size of odontoblasts

The initiation of Odontoblasts differentiation involves the processes of **induction and competence**.

The epithelial cells of the internal dental epithelium are inductive and have been shown to express and secrete several growth factors, which bind to the heparan sulfate, found in the basal lamina. Thereby transferring inductive ability to this structure.

The ectomesenchymal cells of the dental papilla assume competence only following a set no. of cell divisions after which the presumably express the appropriate cell surface receptors able to capture the growth factors now localized at the basal lamina.



Undifferentiated mesenchymal cell (UMC) (A)

UMC with its mitotic spindles perpendicular to basement membrane(B)

Under influence of epithelial cell, D, a daughter cell (C) differentiates into Odontoblasts (E)

Another daughter cell, F, persists as subodontoblastic layer (G)

During final division of ectomesenchymal cells adjacent to the dental epithelium their mitotic spindles are perpendicular to the basement membrane supporting the internal dental epithelium therefore the resulting daughter cells are superimposed, and it is only those cells next to the basement membrane that differentiate into **odontoboasts** and other cells beneath it forms a **subodontoblastic layer** of cells which represent ectomesenchymal cells exposed to the entire cascade of developmental controls for odontoblast differentiation except the last.

FORMATION OF MENTLE DENTIN:

Odontoblasts differentiate in the preexisting ground substance of the dental papilla and that into this ground substance the first dentin collagen synthesized by the odontoblast is deposited.

The first collagen appears extracellularly as very distinct large diameter fibrils (0.1 to 0.2 um in diameter) that aggregate in the structureless ground substance immediately below the basal lamina supporting the internal dental epithelium.

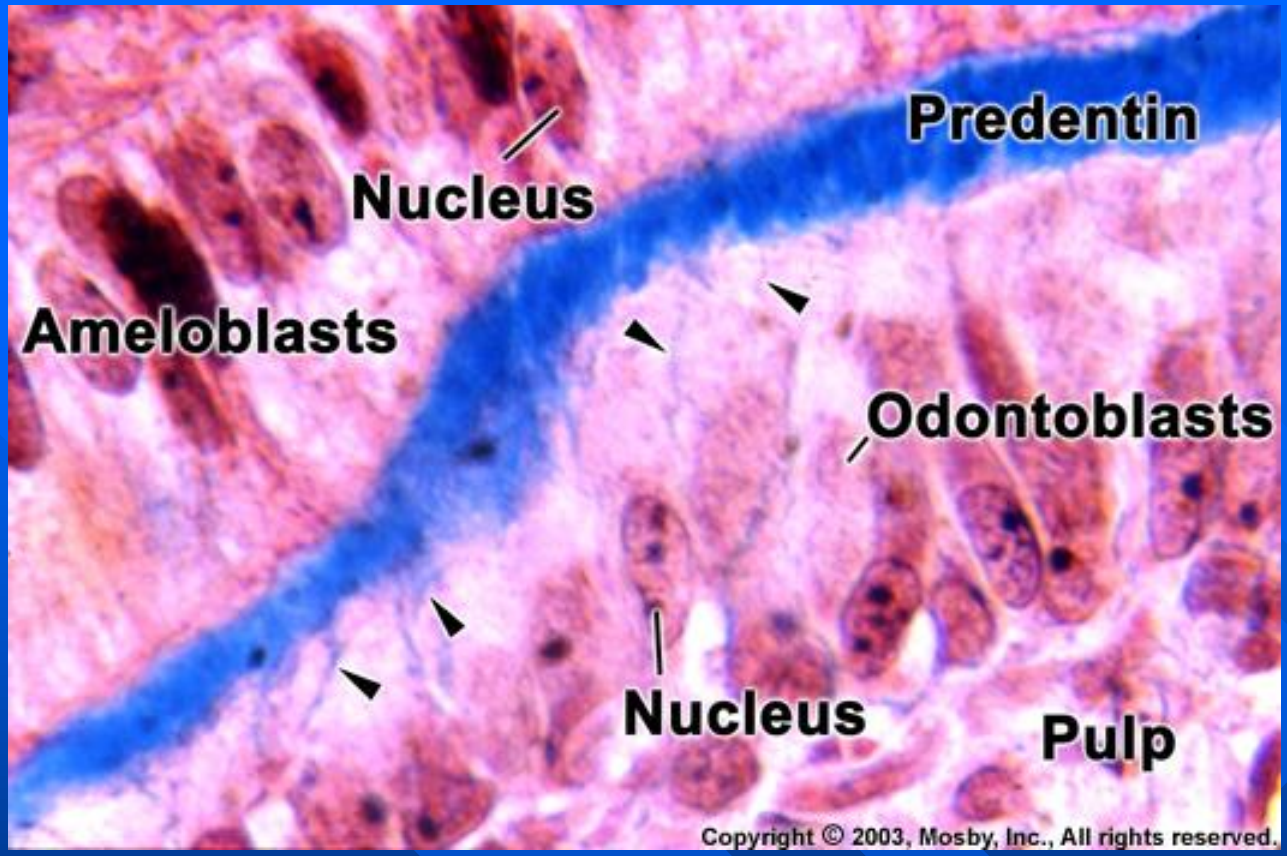
These large collagen fibrils, together with the ground substance in which they aggregate, constitute the organic matrix of the first formed or **mantle dentin**

Coincident with this deposition of collagen, the plasma membranes of the odontoblasts push out short, stubby processes.

As the odontoblast forms these processes it also buds off a number of small membrane bound vesicles known as matrix vesicles, which come to lie between the large diameter collagen fibrils.

The odontoblast then begins to move toward the center of the pulp as it does, one of its short stubby processes becomes accentuated and is left behind to form the principal extension of the cell, the odontoblast process.

Deposition of mineral lags behind the formation of the organic matrix so that there is always a layer of organic matrix, called predentin, found between the odontoblasts and the mineralization front, which is approximately 150 um thick.


Predentin
Nucleus
Ameloblasts
Odontoblasts
Nucleus
Pulp
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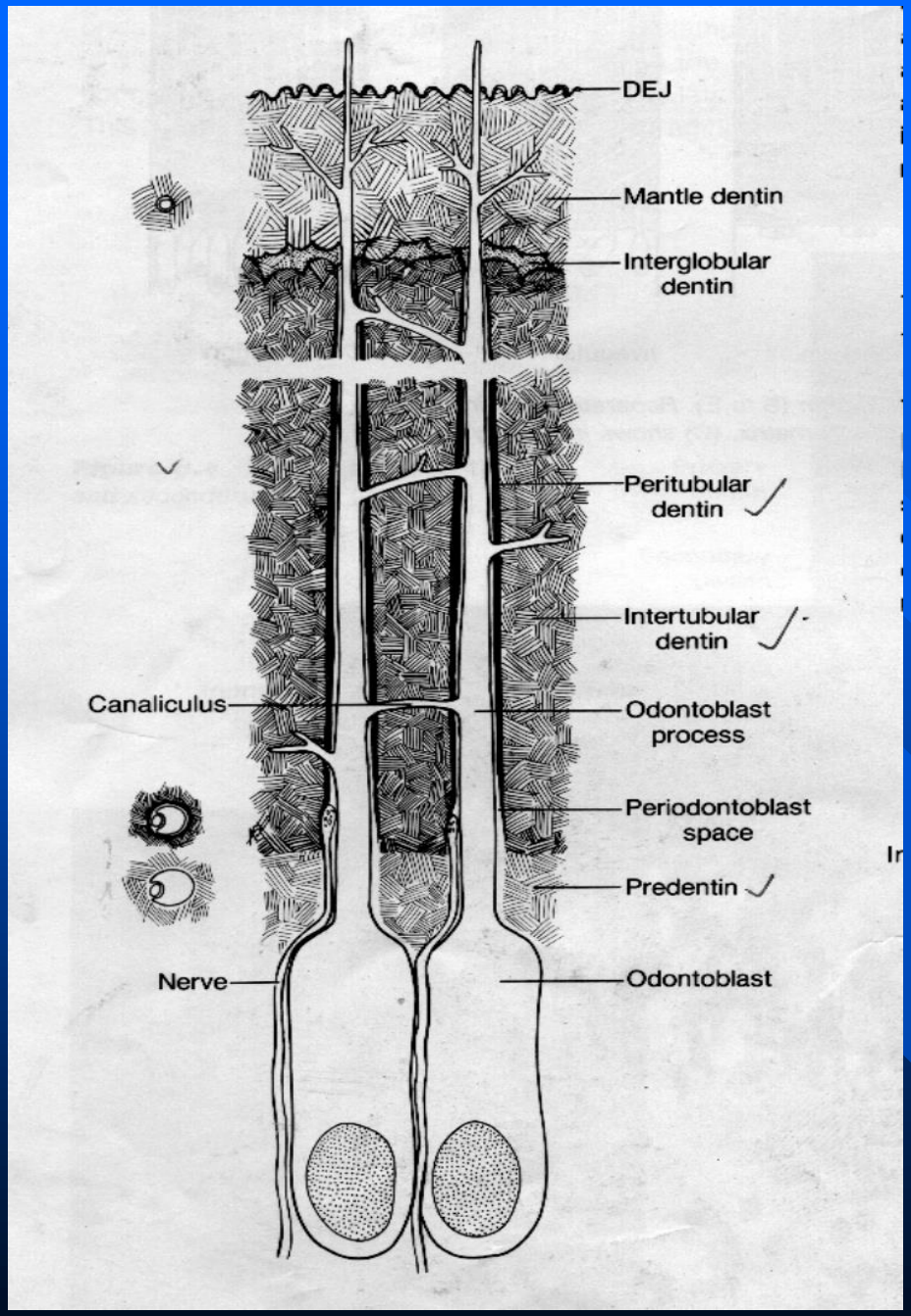
PREDENTIN

FORMATION OF CIRCUMPULPAL DENTIN:

Once the layer of mantle dentin has formed, dentinogenesis continues in a slightly different manner to form circumpulpal dentin.

1. elimination compartment between odontoblasts and all the organic matrix of the dentin is now formed exclusively by the odontoblasts.
2. much smaller collagen fibrils than that of mantle dentin.
3. matrix vesicles are no longer generated by odontoblasts.
4. mineralization is heterogenous nucleation.
5. Odontoblasts adds further components ot the organic matrix e.g. phosphoproteins, phospholipids etc. One phospho protein, phosphoryn is unique to circumpulpal dentin. It is thought to be associated with mineralization. It is a phenotypic marker for mature odontoblasts



The diagram showing …
Odontoblasts & its process
Mantle dentin,
Interglobular dentin
Peritubular dentin,
Predentin,
Canaliculi etc.

MINERALIZATION:

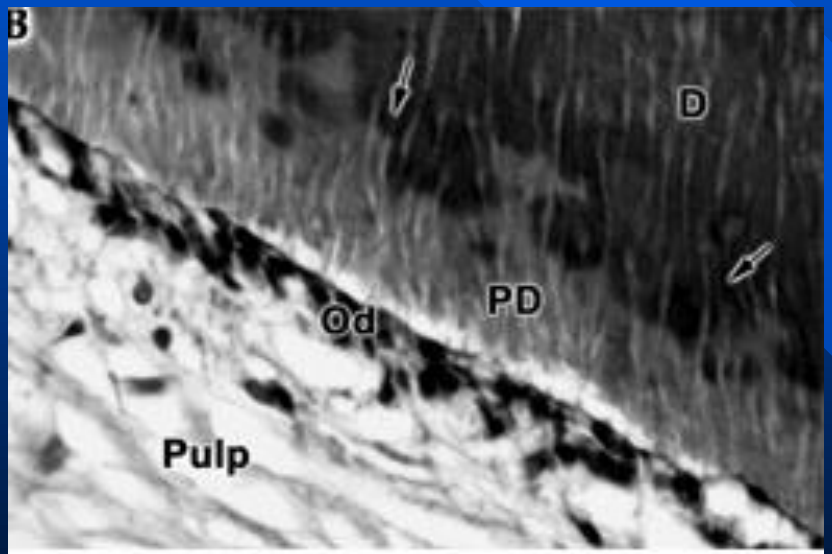
The earliest crystal deposition is in the form of very fine plates of hydroxyapattite on the surfaces of the collagen fibrils.

Hydroxyappatite first appear within matrix vesicles as single crystals.

These crystals grow rapidly and rupture from the confines of the vesicle to spread as a cluster of crystallites that fuse with adjacent clusters to form the fully mineralized matrix.

The crystals associated with the collagen are arranged in an orderly fashion, with their long axis paralleling the fibril axes, and in rows conform to the 64 nm striation pattern.

Mineralization occurs by globular calcification, which involves the deposition of crystals in several discrete areas of matrix by heterogeneous capture in collagen at any time. With continued crystal growth globular masses are formed that continue to enlarge and eventually fuse to form a single calcified mass. This pattern of mineralization is best seen in the circumpulpal dentin formed just below mantle dentin.



Globular mineralization at predentin dentin front (arrows)

INCREMENTAL NATURE OF DENTIN FORMATION:

The organic matrix of dentin is deposited incrementally at a daily rate of approximately 4 um at the boundary between each daily increment, minute changes in collagen fiber orientation can be demonstrated by means of special staining techniques.

Superimposed on this daily increment is further 5 day cycle in which the collagen fiber orientation changes are more exaggerated. This 5 day increment can be readily seen I conventional sections as the **incremental lines of von Ebner** which situated about **20 um** apart.

FORMATION OF ROOT DENTIN:

The differentiation of Odontoblast that form root dentin is initiated by epithelial cells of Hertwig's root sheath.

The product of these root Odontoblasts is structurally and compositionally different fro coronal dentin :

Different orientation of collagen fibers
Less phosphoryn, less degree of mineralization,
Less rate of deposition of dentin.

MOVEMENT OF ODONTOBLASTS:

Odontoblast moves centripetally, leaving behind the formed dentin.

As the cell migrates, it leaves behind a process that comes to occupy a tubule within the mineralized dentinal matrix.

Thus dentinal tubule is a permanent record of the track of the Odontoblast, which in coronal dentin is S shape and in root dentin straight.

Such S shape result from the oscillations of Odontoblasts dictated by their crowding as the surface area they occupy decreases during their centripetal movement.

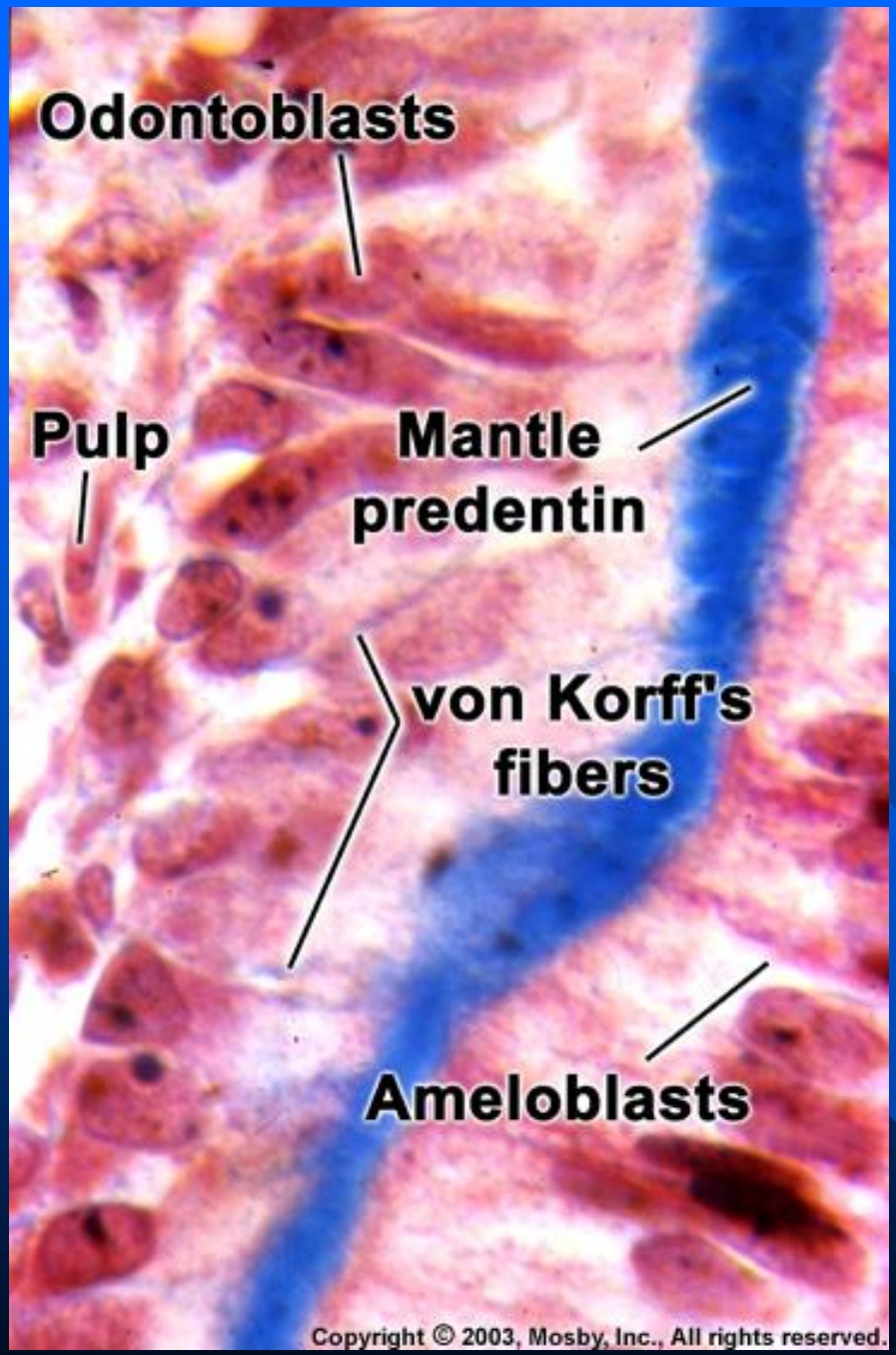
Some Odontoblasts are selectively deleted by apoptosis as they become crowded.

In root dentin formation, where there is no decrease in surface area, the tubules run a straight course.

VON KORFF FIBERS:

At one time it was firmly believed that there was a dual origin for dentin matrix collagen with mantle dentin collagen formed by the activity of cells in the subodontoblast layer and circumpulpal dentin collagen formed as a result of odontoblasts.

Section stained with silver shown large fiber bundles arising from the subodontoblast layer passing spirally between the Odontoblasts to fan out against the surface of the basal lamina in the internal dental epithelium and form the fibrillar component of mantle dentin.



Von korff's fibers during dentinogenesis

But in electron microscopy, these are identified as small particles of silver in an extensive extra cellular compartment.

Thus it is the extensive extra cellular compartment between newly differentiated Odontoblast that capture the silver stain with the result that when viewed by light microscopy a negative outline of the Odontoblasts appears and simulates the outline of fibers.

This explains diminution of the fibers when circumpulpal dentinogenesis begins. As Odontoblasts hypertrophy, they become more closely packed together, develop junctions, and eliminate most of the extra cellular compartment between them. Hence, there can no longer be capture of Silver and therefore no von Korff fibers.

CLINICAL CONSIDERATION:

Cells of the exposed dentin should not be insulted by bacterial toxins, strong drugs, undue operative trauma, unnecessary thermal changes, or irritating restorative materials because when 1 sq. mm of dentin is exposed, about 30,000 living cells are damaged.
It is advisable to seal the exposed dentin surface with nonirritating, insulating substance.

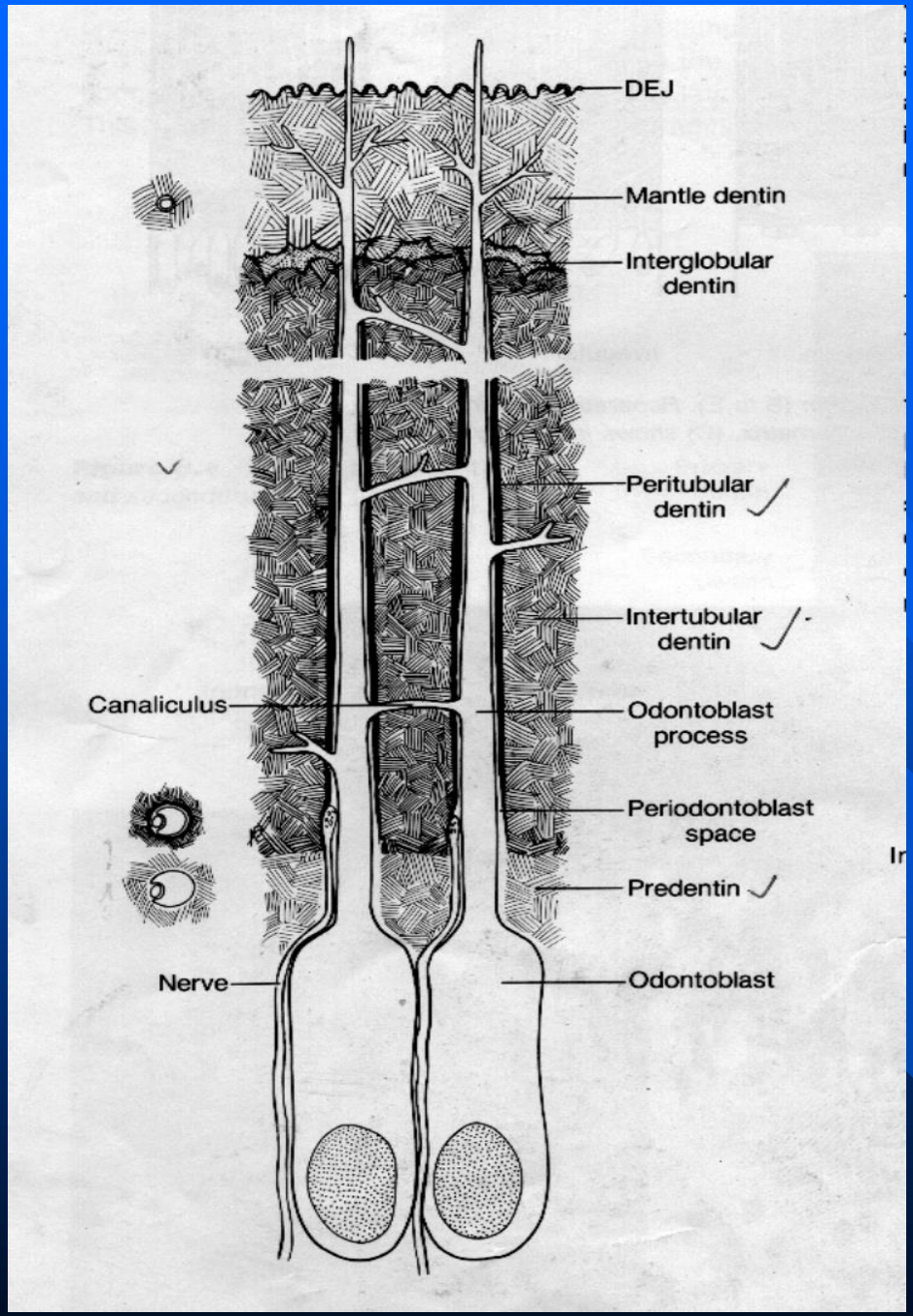
The rapid penetration and spread of caries in the dentin is the result of the tubule system in the dentin.

The dentinal tubules form a passage for invading bacteria that may thus reach the pulp through a thick dentinal layer.

Dentin sensitivity of pain, may not be a symptom of caries until the pulp is infected and responds by a process of inflammation, leading to toothache.

The sensitivity of dentin has been explained by the concept that alteration of the fluid and cellular contents of the dentinal tubules causes stimulation of the nerve ending in contact with these cells.

The teeth with deep, penetrating carious lesions can be treated by only partial removal of carious dentin and insertion of a dressing containing calcium hydroxide, for example, for a period of a few weeks or months. During this period, the Odontoblasts form new dentin a along the pulpal surface underlying the carious lesion and the dentist can they reopen the cavity and remove the remaining bacteria laden decay without endangering the pulp. This treatment is termed indirect **pulp capping.**



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THANK YOU