DENTIN-PULP COMPLEX

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• Introduction
• Overview anatomy & histology of dentin and pulp.
• Development of dentin and pulp
• Structure of dentin and pulp
• Dentin pulp complex zone
• Pulp protection
  - Reparative dentin
  - Sclerotic Dentin
• Dental Sensitivity
  - Pathway of pain
Dentin Pulp Complex

Introduction

Dentin and pulp are embryologically, histologically, and functionally the same tissue and therefore are considered as a complex.
Development of dentin and pulp
Cap Stage of Tooth Development

- Dental (enamel) organ
- Dental papilla
- Dental follicle

*Oral Histology, 5th edition, A R Ten Cate*
Both dentin and pulp have a common origin from the dental papilla.

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Tooth Development

Cell free zone

Odontoblasts

Ameloblasts

Preameloblasts

Preodontoblasts

Acellular zone

Ameloblast with Tomes process

Oral Histology, 5th edition, A R Ten Cate
Dentinogenesis
Structure of dentin and pulp
Types of Dentin

Dentin

Primary physiology dentin
- Mantle dentin

Secondary physiologic dentin
- Circumpulpal dentin
- Peritubular dentin

Tertiary dentin or Reparative dentin or Reactive dentin or Response dentin
- Intertubular dentin
Some Types of Dentin

- Mantle dentin
- Tertiary dentin
- Primary dentin
- Secondary dentin
- Predentin
Types of Dentin

**Primary dentin:** is the dentin formed in a tooth before the completion of the apical foramen of the root. Primary dentin is noted for its regular pattern of tubules.

**Secondary dentin:** is the dentin that is formed after the completion of the apical foramen and continues to form throughout the life of the tooth.

**Peritubular (intratubular) dentin:** dentin that creates the wall of the dentinal tubule.

**Intertubular dentin:** dentin found between the tubules.

**Mantle dentin:** the first formed dentin in the crown closer to the dentinoenamel junction.

**Circumpulpal dentin:** the layer of dentin around the outer pulpal wall.

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Primary physiological dentin

Secondary physiological dentin
Histology structural of Dentin

- Dentinal tubules
- Dentinal matrix
- Intertubular dentin
- Peritubular dentin

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Dr. Md. Nurul Islam
Dentinal tubules
Dentinal matrix
Intertubular dentin
Basic structure of Pulp

- Pulp horn
- Pulp chamber/coronal pulp
- Accessory canal
- Root canal/radicular pulp
- Apical foramen
Basic structure of Pulp

- Pulp is a nonmineralized and vascular tissue.
- Pulp consists of pulp cells, pulp matrix, pulp vessels, and nerves.
- In central pulp region, blood vessels and nerves are present.
- Peripheral region has 3 zones:
  - odontoblastic zone
  - cell-free zone/zone of Weil
  - Cell rich zone.
Dentin pulp complex
Dentin

Predentin

Odontoblasts layer

Cell rich zone

Cell free zone

Pulp core

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Predentin

Cell-free zone

Cell-rich zone

Odontoblastic process

Cell bodies

Nerve ending

Odontoblasts
Odontoblast and Process

- Odontoblast process
- Odontoblast cells
Odontoblast and Process

A, B, C, D: Images showing the structure of predentin and dentin. Images A and C are lower magnifications, while B and D are higher magnifications.

Predentin

Dentin

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Cavity Preparation

- The dentinal tubules are sigmoid ("S") shape curved structure which run perpendicularly from the pulp toward the periphery.
- Near the root tip, incisal edge and cusps, are almost straight.
- The tubules are approximately 1 micron in diameter at their outer end, 1.5 at mid, 1.5 - 3 near the pulp.
- The number of dentinal tubules at the pulp end is nearly 4-5 times more than at outer surface.

The size, curvature and distance between tubules in outer, mid, and inner surface of dentin
Cavity Preparation

The number of dentinal tubules near the pulp end is 4-5 times more than at outer surface.

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Pulp protection
• The dentin formed in response to caries, abrasion, erosion, attrition, or operative procedures is known as **reparative, tertiary, reactive or response dentin**.

• These cause the odontoblasts to be cut or injured → degeneration of a large number of odontoblast.

• The odontoblast that are killed are replaced by the movement of undifferentiated cells from the cell rich zone or from the undiffererntiated perivascular cells present deeper inside the pulp.
Reparative Dentin

Enamel
Restoration
Dead tract
Sclerosed dentinal tubules
Reparative dentin

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Reparative Dentin

- The process of response dentin is started by the pulp.
- It helps seal off the area of injury causing resolution of inflammation & removal of dead cells.
- Reparative dentin has lesser & more twist tubules than normal dentin.
- In some cases, a combination of osteodentin & tubular dentin is also seen.
- The quality and quantity is related to the intensity & the duration of stimulus.
- There is no continuity between dentinal tubules of reparative dentin and overlying primary & secondary dentin.
- There is the minimize dentin permeability at the side deposition thus giving the protection.
Sclerotic or Transparent Dentin

- Sclerotic dentin is generally observed in the elderly people.
- Mineral density is greater in this area.
- It can be present under slowly progressing caries.
- Sclerosis may help to prolong pulp vitality and reduce dentin permeability.
- It appears dark in reflected light, and transparent in transmitted light.
Sclerotic or Transparent Dentin

- The excessive formation of collagen fibers and apatite crystal in dentinal tubules can lead to complete obliteration of dentinal tubules—a defensive reaction of dentin.
- Initially the apatite crystals are only sporadic but gradually a fine meshwork.
- Gradually, the tubule lumen is obliterated with mineral, which appears like quite the peritubular dentin.
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Primary physiological dentin

Secondary physiological dentin

Tertiary dentin

Dead tracts
Primary physiological dentin

Secondary physiological dentin

Tertiary dentin

Primary physiological dentin
Dentin sensitivity
1. Suggests that the dentin is innervated directly (direct innervation theory).

2. Suggests that odontoblast acts as receptor (transduction theory)

3. Suggest that the receptors are in the pulp and are stimulated by fluid movement through the tubules (hydrodynamic theory)
Direct innervation theory

- This theory stated that the nerve endings in the dentin, when stimulated, evoke a painful response.
- However, no nerve fibers could be demonstrated going to DEJ (which is the most sensitive area).
- Dentin sensitivity doesn’t solely depend on the stimulation of such nerve ending.
Transduction theory
(odontoblast as receptor)

- This theory states that the odontoblast process is the primary structure excited by stimulus.
- Odontoblasts are derived from the neural crest cells.
- The odontoblast retain the ability to transmit and propagate an impulse. It is not popular since there are no neurotransmitter vesicles present in the gap junction between odontoblasts.
Hydrodynamic theory

- The dentinal tubules contain fluid called dental lymph.
- Various stimuli affect fluid movement in the dentinal tubules & stimulate the pain mechanism by mechanical disturbance of the nerve closely associated with the odontoblast process.
- The stimuli may be heat, cold, desiccation, mechanical, chemical or osmotic pressure.
Reference


Optional: