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Endo is a Greek word for “Inside” and Odont is Greek word for “Tooth”. **Endodontics:** is the branch of clinical dentistry which is concerned with the morphology, physiology, pathology of human dental pulp and periradicular tissue, it also concerned with diagnosis and treatment of the diseases and injuries of these tissues.

OBJECTIVE OF ENDODONTIC TREATMENT

The objective of endodontic therapy is to treat the affected tooth to become symptom free (biologically acceptable) without diagnosable pathology and functional.

This objective can be achieved by eliminating the bacteria (source of infection) from the root canal system, and sealing the root canal and tooth to prevent re-infection.

When the dental pulp is diseased or injured, treatment is aimed at preserving normal peri-radicular tissues. When apical periodontitis has occurred treatment is aimed at restoring the peri-radicular tissues to health: this is usually carried out by root canal treatment, occasionally in combination with surgical endodontics.

INDICATIONS FOR ROOT CANAL TREATMENT

1. An irreversibly damaged or necrotic pulp with or without clinical and/or radiological findings of apical periodontitis.
2. Elective devitalization, e.g. to provide post space, prior to construction of an overdenture, doubtful pulp health prior to restorative procedures, likelihood of pulpal exposure when restoring a (misaligned) tooth and prior to root resection or hemisection.

CONTRAINDICATIONS FOR ROOT CANAL TREATMENT

1. Teeth that cannot be made functional nor restored.
2. Teeth with insufficient periodontal support.
3. Teeth with poor prognosis, uncooperative patients or patients where dental treatment procedures cannot be undertaken.
4. Teeth of patients with poor oral condition that cannot be improved within a reasonable period.

The pulp

The pulp is connective tissue system composed of cells, ground substances, collagen fibres, interstitial fluid, odontoblasts, fibroblasts and other cellular components. Embedded in this stroma, blood vessels, lymphatics and nerve fibers are present.

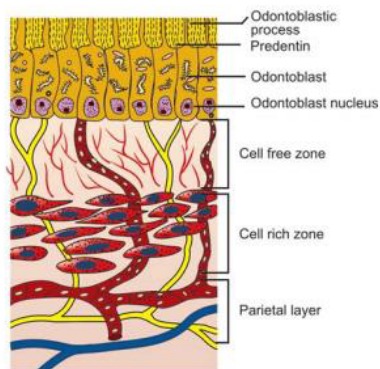
When pulp is examined histologically, it can be distinguished into four distinct zones from periphery to center of the pulp as shown in Figure below. The zones are as following:

A. Odontoblastic layer at the pulp periphery: Odontoblasts consists of cell bodies and cytoplasmic processes.

B. Cell free zone of Weil: Central to odontoblasts is sub-odontoblastic layer, it contains plexuses of capillaries and small nerve fibres.

C. Cell rich zone: It contains fibroblasts, undifferentiated cells which maintain number of odontoblasts by proliferation and differentiation.

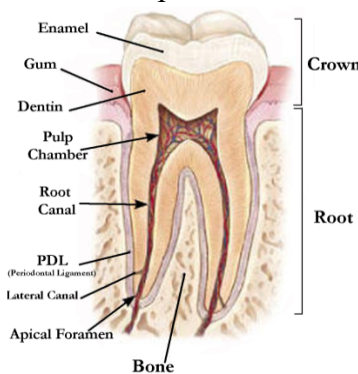
D. Pulp core: It contains large vessels and nerves from which branches extend to peripheral layers.



Contents of the pulp	
I. Cells	<ol style="list-style-type: none"> 1. Odontoblasts 2. Fibroblasts 3. Undifferentiated mesenchymal cells 4. Defense cells - Macrophages, Plasma cells, Mast cells
II. Matrix	<ol style="list-style-type: none"> 1. Collagen fibers - Type I, Type II 2. Ground Substance - Glycosaminoglycans, Glycoproteins, Water
III. Blood Vessels	- Arterioles, Venules, Capillaries
IV. Lymphatics	- Draining to submandibular, submental and deep cervical nodes
V. Nerves	- Subodontoblastic plexus of Raschkow - Sensory afferent from Vth nerve and Superior cervical ganglion

ANATOMY OF DENTAL PULP

- ☐ Pulp lies in the center of tooth and shapes itself to miniature form of tooth.
- ☐ This space is called pulp cavity which is divided into a pulp chamber and root canal/s starting from the orifice to the apical foramen.
- ☐ There are also accessory and lateral canals.
- ☐ The shape of root canal varies with size, shape, number of the roots in different teeth.



FUNCTIONS OF PULP

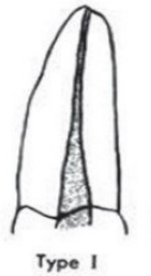
Pulp performs four basic functions:

1. Formation of dentine.
2. Nutrition of dentine.
3. Innervation of tooth.
4. Defense of tooth.

ROOT CANAL CONFIGURATION

The shape of root canals is divided into four types:

Type 1: A single canal leaving the pulp chamber and continuing as a single canal to the root apex and opens in a single apical foramen. It refers to **1-1-1**



Type 2: Two canals leave the pulp chamber then join each other at the apical third to open in a single apical foramen. It refers to **2-1-1**



Type 3: Two canals leave the pulp chamber and continue as two canals to be opened in two separate apical foramina. It refers to **2-2-2**



Type 4: A single canal leaving the pulp chamber, and bifurcating at the apical third into two canals and open in two apical foramina. It refers to **1-2-2**



BASIC PHASES OF TREATMENT

There are three basic phases of treatment:

- 1- The Diagnostic phase in which the disease to be treated is “determined “and the treatment plan developed.
- 2- The Preparatory phase in which the contents of the root canal are removed and the canal is prepared to receive a filling material.
- 3- The obliteration Phase in which the canal is filled or obliterated with an inert material to obtain an adequate seal as close as possible to C.D.J. (cementodentinal junction).

If there is a defect in any phase, the endodontic treatment will not be succeeded.

PULP AND PERI-RADICULAR PATHOLOGY

Etiology of pulpal diseases can be broadly classified into:

I. Bacterial irritant

Bacteria, usually from dental caries, are the main source of injury to the pulpal and periradicular tissues and they enter either directly or through dentine tubules.

Modes of entry for bacteria to the pulp are as follows:

- 1- Through the carious cavity.
- 2- Through the dentinal tubules as in contamination during cavity preparation, through exposed root surface, and surfaces with erosion, abrasion and attrition.
- 3- Through the apical foramen as in advanced periodontitis where microorganisms reach the apical foramen and then the pulp.
- 4- Through the blood stream (anachoresis: it is a process by which microorganisms get carried by the bloodstream from another source localize on inflamed tissue). Following trauma or inflammation to the pulp any bacteria in the blood might be attracted to the pulp causing pulpitis.
- 5- Through faulty tooth restoration.
- 6- Through extension of a periapical infection from adjacent infected tooth.

II. Mechanical irritants

Examples of mechanical irritation include trauma, operative procedures, excessive orthodontic forces, subgingival scaling and over instrumentation using root canal instruments.

III. Chemical irritants

Pulpal irritation may result from bacterial toxins or some restorative materials/conditioning agents. Periradicular irritation may occur from irrigating solutions, phenol-based intra-canal medicaments or extrusion of root canal filling materials.

Classification of Pulp Disease

Diagnosis of pulp disease is usually based on patient symptoms and clinical findings. Pulpal disease may result in changes to both the soft and hard tissues.

Soft tissue changes

Reversible pulpitis (Pulpal Hyperaemia): It is a transient condition that may be precipitated by any insult (ex. caries) to the pulp and characterised by increase in vascular vasodilation.

The symptoms are usually:

- Pain needs an external stimulus and it subsides immediately after removal of stimulus.
- Pain is difficult to localize (as the pulp does not contain proprioceptive fibers).
- Normal periradicular radiographic appearance.
- Teeth are not tender to percussion but sensitive to cold stimulus.

Treatment involves covering up exposed dentine, removing the stimulus or dressing the tooth.

Irreversible pulpitis: Irreversible pulpitis usually occurs as a result of more severe insults than in the reversible pulpitis. It may develop as a progression from a reversible state.

1) Acute pulpitis. The pulp experiences increased inflammatory process and intrapulpal pressure. The symptoms experienced are:

- Severe pain develops spontaneously or from stimuli which may last from minutes to hours.
- Rapid onset of pain, which can be caused by sudden temperature change, sweet or acidic food.
- Pain remains even after removal of stimulus.
- Pain exacerbated on bending down or lying down due to change in intrapulpal pressure.
- Not tender to percussion and normal radiographic apical region.
- a widened periodontal ligament may be seen radiographically in the later stages.

Treatment involves either root canal therapy or extraction of the tooth.

2) Chronic pulpitis. After the acute phase the pulp might enter the chronic phase. The symptoms experienced are:

- Mild to moderate intermittent pain may be tolerated by the patient for long period of time.
- Thermal tests are of little value.
- Tenderness to percussion and radiographic changes are not seen until infection reaches the periapical region.

Treatment involves either root canal therapy or extraction of the tooth.

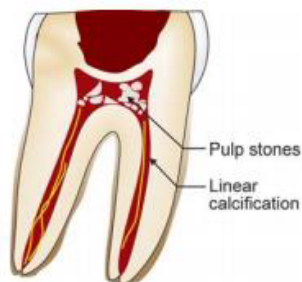
Hyperplastic pulpitis: Hyperplastic pulpitis is a form of irreversible chronic pulpitis and is also known as a **pulp polyp**. It occurs as a result of proliferation of chronically inflamed young pulp tissue. Treatment involves root canal therapy or extraction.



Pulp necrosis: Pulp necrosis occurs as the end result of irreversible pulpitis; treatment involves root canal therapy or extraction.

Hard tissue changes

Pulp calcification: Physiological secondary dentine is formed after tooth eruption and the completion of root development. It is a condition in which hardening, or calcification, of pulp tissue results in hypersensitivity and extreme pain because the dental nerves become compressed. A root canal is usually necessary to clear away hardened tissue. Pulp calcification is deposited on the floor and ceiling of the pulp chamber rather than the walls and with time can result in occlusion of the pulp chamber. Pulp calcification may be composed of irregular dentine (true denticle) or due to ectopic calcification of pulp tissue (false denticle). Tertiary dentine is laid down in response to environmental stimuli as a reparative dentine where it is deposited directly beneath the path of injured dentinal tubules as a response to strong noxious stimuli. Treatment is dependent upon the pulpal symptoms.



Internal resorption: Internal resorption is initiated within the pulp cavity and results in loss of substance from dentinal tissue. Occasionally, pulpal inflammation may cause changes that result in dentinoclastic activity. Such changes result in resorption of dentine; clinically, a pink spot may be seen in the later stages if the lesion is in the crown. Radiographic examination reveals a radiolucency that is seen to be continuous with the rest of the pulp cavity. Root canal therapy will result in arrest of the resorptive process; however, if destruction is very advanced extraction may be required.



Why does patient Feel Pain?

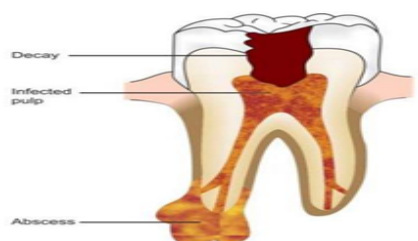
When pulp becomes infected, it causes increased blood flow and cellular activity, and pressure cannot be relieved from inside the tooth. This causes pain. Pulp can even die without causing significant pain; it may depend on pain threshold and pain reaction of the patient.

What are Alternatives to Root Canal Therapy?

If tooth is seriously damaged and its support is compromised, then extraction is only alternative.

How can You Tell if Pulp is infected?

When pulp gets inflamed, it may cause toothache on taking hot or cold, spontaneous pain, pain on biting or on lying down. On occasion a damaged pulp is noticed by drainage, swelling, and abscess at the root end . Sometimes, however, there are no symptoms.



Can All Teeth be Treated Endodontically?

Most of the teeth can be treated endodontically. But sometimes when root canals are not accessible, root is severely fractured, tooth cannot be restored or tooth doesn't have sufficient bone support, it becomes difficult to treat the tooth endodontically. However, advances in endodontics are making it possible to save the teeth that even a few years ago would have been lost. Newer researches, techniques and materials have helped us to perform the endodontic therapy in better way with more efficiency. Since introduction of rotary instruments and other technologies reduce the treatment time, the concept of single visit is gaining popularity nowadays. It has been shown that success of endodontic therapy depends on the quality of root canal treatment and not the number of visits. In the modern world, single visit endodontics is becoming quite popular.