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## Apical third and its significance

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**Abstract---**Beyond the simple perception is often the intricate internal anatomy and a complex root canal system. Studies on the anatomy of the root apex are an area of interest to the endodontist. The apical limit of root canal instrumentation and obturation is one of the critical controversial tissues in root canal therapy. Appreciable knowledge of the morphology of the root apex and its variance, ability to interrupt it correctly in an radiographs, and to felt it through tactile sensation during instrumentation are essential for an effective rendering of the treatment of root canals.

**Keywords---**apical limit, root canal instrumentation, obturation.

## **Introduction**

Anatomy is the major foundation of art and science of healing. Of all the phases of anatomic study in human system, one of the most complex is root canal system.(1)The root apex is of interest to endodontists because the stages of root development and the types of tissue present within the roots of teeth are significant for the practice of endodontics. Achievement of an perfect seal at the apex of the canal using an inert filling material is the ultimate goal of every endodontist.(2)

## **Development of root apex**

The development of the root begins only after the enamel and the dentin formation has reached the future CEJ. Various steps involved are: Formation of HERTWIG'S EPITHELIAL ROOT SHEATH, Formation of EPITHELIAL DIAPHRAGM, Formation of DENTIN IN THE ROOT, Formation of CEMENTUM.(3)

## **Apical morphology**

Apical constriction is the apical portion of root canal with the narrowest diameter also called as MINOR DIAMETER ideally, the root filling should stop at this constriction as it would serve as –apical dentin matrixl. Multiple shapes of apical –constriction which was given by Dummer *et al.*, Parallel 35%,Single 18%, Tapering 15%, Flaring 18%,Delta 12%.(4) Cementodentinal junction- point in the canal where cementum meets the dentin also defined as the junction where pulp tissue ends tissue ends and periodontal tissue begins. The diameter of the canal at CDJ was extremely irregular and was determined to be 3.53 mm for maxillary centrals, 2.92 mm for lateral incisors and 2.98 mm for canines.(5)

Accessory canals are the channels that lead from the radicular pulp laterally through the root dentine to periodontal tissue.Some open approximately at right angles to the main pulp cavity are termed –lateral canals.(6) If root canal break up into multiple tiny canal it is referred to as delta system because of its complexity.In many teeth with a fused root there is a web like connection between two canal called isthmus.(7)

## **Accessory canals and foramina / lateral canal**

Minute canals that extend in a horizontal,vertical or lateral direction from the pulp to the periodontium.In the tooth it is a channel leading from the root pulp laterally through the dentin to the periodontal tissue.(8) Development: The mild trauma to which the tooth is subjected during development of the root apex, may cause disturbance or breakage in the continuity of the Hertwig's root sheath more frequently, thus leading to the formation of many accessory canals and foramina in the apical third of the root. Lateral canals may occur where the developing root encounters a blood vessel Many a times during the formation of the root sheath, break develops in the continuity of the sheath, producing a small gap. When this occurs, dentinogenesis does not take place opposite the defect. The result is a small accessory canal between the dental sac and the dental

pulp.Incidence:73.5%-apical third of the root,11.4%-middle third,15.1%-cervical third.(2)

### **Clinical significance**

Lateral/accessory canals are generally difficult to clean adequately. These canals emphasize the need for employing effective irrigating solution and irrigating techniques and also highlight the need for three dimensional filling of the root canals. Lateral canals of significant diameter are sometimes found in floor of the pulp chamber. They can transmit toxins/irritants from the pulp cavity and establish lesion in the furcation. A tooth with multiple accessory canals in the apical third can harbor microorganisms in these channels and may continue to irritate the periapical tissue.(9)

### **Denticles and dystrophic mineralisation**

Seltzer et.al. 1966 found dystrophic mineralisation in the apical pulp tissue of approximately 25% of anterior teeth. Pulp stones are nodular calcified masses appearing in either or both the coronal or root portions of the pulp organ comprised of tubular dentin and alveolar mineralized material. Normally found as – attached, embedded, adherent (only part of it is attached to the dentin).(2)

### **Clinical significance**

Results in Difficulty in root canal instrumentation during reaming and filing of apical third..Pulp stones can be dislodged during instrumentation and may block the apex of the tooth.When large denticles are present, they may interfere with extirpation of the entire pulp or removal of the coronal portion of pulp.If detached gets impacted into the foramen rendering instrumentation difficult.(10)

### **Apical resorption**

Shallow resorption of the dentin in the apical portion of the root canal are normal occurrence:

### **Causes of apical resorption**

1. Orthodontic treatment.
2. Accident / trauma.
3. Surface resorption
4. Inflammatory resorption.
5. Replacement resorption

### **Clinical significance**

In any event if apical resorption has taken place,the position of apical foramen and apical constriction would change accordingly and thus the working length measurement also. According to “weine” If there is no resorption of root end or bone then shorten the length by the Standard 1mm.If periapical bone resorption

is apparent then shorten by 1.5mm.If both root and bone resorption are apparent then shorten by 2mm.(11)

### **Microbiology of apical third**

Most of the bacteria in an endodontic infection are predominantly anaerobes.VARIOUS MICROORGANISMS INVOLVED ARE:

“Baumgartner and Falker” reported that prevalent species in apical third are: Prevotella Intermedia, Peptostreptococcus Anaerobicus, Veillonella parvula, Porphyromonas, Fusobacterium(12)

In retreatment cases organism am negative bacteria present in apical third is mainly gram negative bacteria- ENTEROCOCCUS FEACALIS. C.Albicans also have been detected by culture in apical third region in endodontic infections.(13)

### **Apical Preparation**

#### **Length determination**

The first step in the preparation is the location of the foramen in the root apex. Although the radiographic assessment with a measured endo instrument in the canal is an accepted procedure for the determination of the tooth length, measurements using electronic instruments are becoming increasingly popular. Electronic measurement of the tooth length according Grossman (1981), is an effective method in 80 to 90% of the cases compared to the radiographic method. Neosono D, indicates the exact location of the foramen with reasonable accuracy. Galland (1985) recommends electronic apex finder for those who perform endo treatment infrequently.(10)

#### **Instruments & instrumentation**

Ninety percent of canals are curved (Christie & Peikoff 1980), and precurving of the files is necessary in all such cases. By precurving the instruments the original course of the canal and the location of the foramen are maintained. Files never should be given quarter turn bites into dentin or pulled forcibly with lateral pressure along the canal walls when preparing the apical end of the canal. Rotation of the instruments has found to be violating the basic principle as it forms an ‘hour glass’ outline rather than a smooth taper near the apex (Weine et al. 1975). Most of the times Flexible files are preferred over stiffer varieties since they may change the course of the canal, form a ledge or transport the foramen by ripping. The new K- type file (triangular cross sections ) is more flexible than H- file (Roane et al 1985)(11).

#### **Methods of preparation**

Preparation design has an extreme influence upon the final seal. Step back or flaring type of preparation of an apex is found to be advantageous over conventional method (Allison et al. 1979). Flared preparation always provides a cleaner environment also better receptacle for an obturating material, and

stronger apical dentin matrix (Weine 1982). Chances of apical ripping and shifting of the foramen are very less with step- back technique (Christie & Peikoff 1980). Various special techniques are being introduced by different clinicians for acceptable preparation of a curved apical third (Mullaney 1979; Weine 1982; Roane et al. 1985).

### **Irrigation**

A strict rule is to irrigate the canal copiously between each instrumentation. It mainly facilitates the removal of dentin shavings and also maintains the cutting efficiency of the instruments by relieving clogging. Once the dentin mud settles at the apical level, it becomes very difficult to be dislodged. Since 1955, Grossman (1982) has suggested the alternate use of 5% NaOCl with 3% hydrogen peroxide. The effervescence obtained on using hydrogen peroxide, he stated would bring the shavings to surface. Furthermore, effervescence due to use of 3% hydrogen peroxide always bubbles in upwards direction. Hence, the use of the same in an maxillary teeth would detrimentally drive the mud apical wards instead of upwards (Schilder & Yee 1984). The circulation of the irrigant has been found to be remain short of the apical third of the canal, particularly in curved teeth, unless specially made fine needles are used (Goldman et al 1976)(13) Chlorhexidine has been suggested for endodontic use due to its broad spectrum antimicrobial activity and least irritant nature on the periapical tissues. However, its inability to dissolve tissue fragments has been quite a problem. Though NaOCl is considered as the irrigant of choice, chlorhexidine gluconate should be strongly considered in conditions such as young permanent teeth with immature apices or open apices.

### **Obturation**

Sealing is done in order to eliminate all the portals of entry from the root canal into the adjacent periodontal tissues through which exudates, bacteria or their toxins might pass; and to make the environment free and favourable for healing. Ingle (1956) determined 63% of the root canal failures only because of inadequate filling. Accessory foramina if left open and remain unfilled can also lead to failure of treatment.

Ideal response after endodontic treatment is the biologic closure of apex. Many methods were tried. Nysgaard Ostby (1961) attempted natural healing at the apex by inducing bleeding within the canal. The subsequent formation of the clot within canal was hoped to serve as a matrix for tissue ingrowth. However, the formation of biological closure was found to be negated as the clot fibrin was observed to degenerate within the canal coronally. The pulp at the apex has been advised (Leonardo et al 1984) not to be disturbed; extreme care and respect needs be shown to the vitality of the pulp.

## **Significance of apical third**

### **During irrigation**

The ability of an irrigant to be distributed to the apical portion depends on canal anatomy, size of instrumentation and mode of delivery system. Substances that have been used to rinse and chemically clean root canals should be non-toxic. Excess pressure into canals during irrigation should be avoided to prevent extrusion of irrigant into periapical tissues. It is strongly recommended that needles lie passively in the canal and not engage the walls. Other important factor is volume of irrigant and irrigating needle although larger gauge needle allows irrigant to be flushed and replenish more quickly, the wider needle diameter does not allow cleaning of apical and narrower areas of root canal system. (13)

### **During obturation**

Obturation is a reflection of cleaning and shaping. Termination of root canal filling depends on the anatomic limits of the pulp space which are dentinocemental junction is an average of 0.5-0.7 mm from external surface of the apical foramen and is a major factor in limiting filling material to the canal. Kuttler stated that the apical point of termination should be 1mm from radiographic apex, which remains rational and the point of termination of the preparation and obturation remains empiric. (14)

### **Conclusion**

The morphological variations and the technical challenges involved in the treatment of apical third seems infinite. Inadequate attention and improper handling of apical third of the root may lead to serious implications but with introduction of higher technology and advancement in endodontics the problem is bound to be solved soon

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