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Review Article

Root Canal Treatment in Primary Teeth

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Abstract

Introduction: The loss of tooth structure at an early stage may lead to various problems in terms of functional, physiological and aesthetic forms. The structure of primary dentition is such that it is more prone to decay and progresses easier and faster in no time; in this way, there is a frequent need for dental pulp treatment. The emergence of enormous preventive measures in pediatric dentistry has reduced caries, but the premature loss of primary teeth due to pulpal involvement remains a common problem. These often lead to mesial drifting and further give rise to malocclusion. The arch space is best preserved with retention of pulpally decayed primary tooth, in a condition where teeth can be restored to its normal form and function and be free of pathology. Endodontic treatment in deciduous dentition can be challenging and time-consuming. The advent of new material and rotary system such as Ni-Ti and rotary files, the endodontic treatment has become cost-effective and resulted in consistent and predictable prognosis. Despite that, conventional instrumentation technique remains the 'gold standard'.

Aim of the Study: The purpose of this review is to understand the endodontic treatment as well as the materials and techniques used in deciduous dentition.

Methodology: The review is a comprehensive research of PUBMED from the year 1925 to 2017.

Conclusion: The endodontic treatment will have a big role in the treatment of pulpally involved deciduous teeth unless the protective treatment becomes common. This need for the treatment brings to a search for new technique material. Mineral trioxide aggregate (MTA) is a commonly used material in deciduous endodontic treatment in recent years and is gradually developing and enhancing with time. Apart from MTA, the products which form hard tissues and have antibacterial properties are useful to have been regularly used in various studies; as a result of these advancements in technique and material, endodontic treatment in deciduous teeth can be given more successfully and which in turn can avoid the early loss of tooth and its further consequences. This eventually resolves the problems regarding permanent tooth development.

Keywords: *Root Canal in Deciduous Teeth; The Morphology of Deciduous Teeth; Ni-Ti Rotary System; Obturation; Obturating Materials*

Tooth decay in children is very frequently seen, but decay prevention programs are lower, especially in the regions where protective dental application are not fully developed, these deep carious lesions are found be more prevalent among candidates with poor oral hygiene and dietary habits as well as lack of proper oral hygiene education. The wide occlusal surface with deep grooves, flat contact areas make the deciduous teeth more prone to caries [1].

The anatomy of deciduous teeth also contributes to early pulpal involvement since the thickness of enamel and dentin is half that of permanent teeth. The pulp horns are higher placed in dentin, the large width of dentin canals as well as the increased permeability of dentin as it closer to pulp aids in progressing carious lesion much faster, which ultimately requires a pulp treatment [1].

The objective to retain the integrity of primary dentition are as follow [2]:

1. Preserve mesial drift of permanent teeth, thereby preventing malocclusion.
2. Preserve arch space.
3. Aid in mastication.
4. Serve in the absence of a succedaneous tooth.
5. Prevent aberrant tongue habits.
6. Prevent psychological effects associated with early tooth loss.
7. Maintain aesthetics.
8. Prevent possible speech problems.
9. Maintain normal eruption time of the permanent teeth.

The failure rate of pulp capping is high in deciduous teeth, and therefore, it is not indicated in carious exposures of deciduous teeth. All the exposures in deciduous teeth should be treated either with a pulpotomy, pulpectomy, or extraction. Formocresol pulpotomy is the most accepted procedure in deciduous teeth with a higher success rate to save pulpally involved deciduous teeth. To this success rate, the inflammation must be confined to the coronal portion of the pulp cavity [3,4].

Formocresol cannot be indicated in the following conditions, and thus, the following conditions are an ideal candidate for root canal therapy or extraction in many cases [3,4]:

1. History of spontaneous pain.
2. Pain on percussion due to the presence of a periapical lesion.
3. Presence of a parulis or sinus tract.
4. Evidence of periapical or furcal pathology.
5. Suppuration in the canals.
6. Presence of necrotic pulp in the chamber.

Anatomy of root canal and morphological changes in deciduous teeth

Before starting of root canal therapy, the clinician must have thorough knowledge and understanding of morphologic changes that continually occur within deciduous teeth, and the difference between deciduous and permanent teeth root canal anatomy should be known. The root canal of anterior deciduous teeth is relatively simple, with fewer irregularities, and is often easy to treat endodontically. The root canal configuration of posterior deciduous teeth is more complicated to treat due to the presence of deltas between the canal and many ramifications, making a thorough debridement very difficult. Generally, in each deciduous molar, there is only one canal present when the entire root formation process has been completed. As the root length is completed, the deciduous teeth began to resorb; as a result of this resorption, the position of the apical foramen changes continually. Along with this process, the secondary dentin starts depositing within the root canal system [5-7].

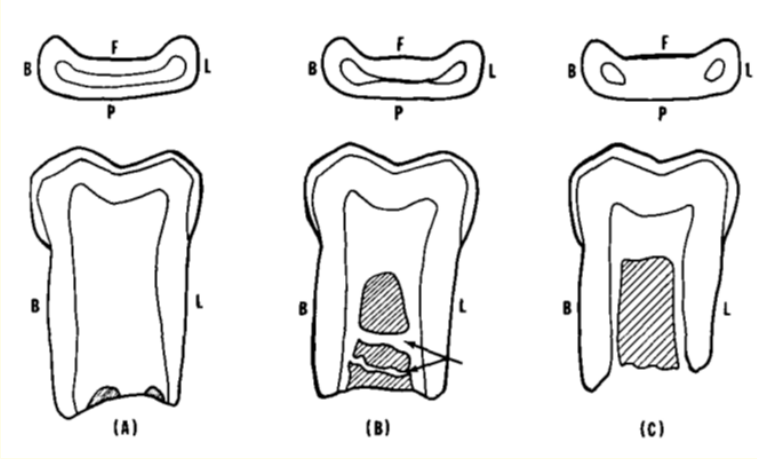

Figure 1: *Showing the cross-section and sagittal section of the mesial root of the primary mandibular molar. (A) The initial formation of the root with only one canal present. (B) As the tooth develops, there is a deposition of secondary dentin (lined areas) within the root canal system and continual resorption of the root apex. Small fins and connecting branches develop between canals (arrows). (C) During the late development of the tooth, canals are completely divided as the roots continue to resorb [9].*

This dentinal deposition produces variation and alters the number and size of a root canal, connecting branches or fins between facial and lingual aspects of canals, with continued deposition leading to separation of the canal. Lateral canals, accessory canals, and apical ramification of pulp are observed in many deciduous teeth. The maxillary molar may have two to five canals, the palatal root of which is rounder and longer than buccal roots. Mesio-buccal root has two canals in 75% of cases. The fusion of palatal and distobuccal roots is also evident in one-third of deciduous maxillary first molars. Deciduous mandibular molars usually present with three canals, and two to five canals may be occasionally found. Mesial roots contain two canals in both first and second deciduous molars, with two canals seen in distal root in 25% of cases [6-8].

Root canal irrigation agents

Sodium Hypochlorite	Sodium hypochlorite is a commonly used irrigating agent in root canal therapy because of its properties of solving vital and non-vital tissues, wide-spectrum antibacterial activity, easy availability, and cost-effectiveness. Various studies have suggested that 1% sodium hypochlorite solution with 6% citric acid can give better result in irrigation for deciduous teeth. Various percentages such as (4%,6%, and 8%) citric acid have been used for removal of smear layer during root canal procedure. Sodium hypochlorite is proven to be successful against *Enterococcus faecalis* in deciduous root canals and was found to remove the smear layer [10]
Chlorhexidine gluconate	Chlorhexidine gluconate is also a broad-spectrum antimicrobial agent used as an irrigant because of its tissue-solving quality. It is also known to be effective Enterococcus faecalis in deciduous root canals. According to some studies, 2% chlorhexidine gluconate has more antibacterial effect and less toxic effect than 5, 25% sodium hypochlorite [11].
Ethylenediaminetetraacetic acid (EDTA)	Ethylenediaminetetraacetic acid (EDTA) is a chelating agent that works on the principle of demineralization of tissue and increases the permeability of dentine. This makes root dentine more friable and easy to remove on instrumentation. Along with sodium hypochlorite, it is highly effective in the removal of the smear layer [12].
Mixture of tetracycline, acid, and detergent (MTAD)	A mixture of tetracycline, acid, and detergent (MTAD) is a root canal irrigation solution that includes tetracycline and acid as its ingredients. It has an antibacterial effect against *Enterococcus faecalis* and other bacteria isolated from deciduous teeth. MTAD is also known to remove the smear layer in deciduous root canals [13].
Others	Sterile saline solution is the most biocompatible root canal irrigation solution used in deciduous dentition because of its non-toxic qualities to periapical tissues; it is considered safe in children. However, it does not possess characteristics like antibacterial and smear removal properties like other root canal irrigation solutions, so it is mostly used in combination with other solutions [14]. Apart from these, ozonized water and propolis has been used as an irrigation solution because of its antibacterial properties and effectiveness against *Enterococcus faecalis* [15].

Root canal materials used in deciduous dentition

Calcium hydroxide	Calcium hydroxide is a preferred root canal sealing material because of its high level of biocompatibility, alkaline pH, and it can be absorbed out of the root canal system. Apart from this, they can be easily prepared and applied with no irritant effects on periapical tissues. They also do not tend to have a toxic effect on the permanent dental germ. The material is reported to have antibacterial properties on bacteria isolated from deciduous tooth canals. Although there are many advantages of calcium hydroxide, however the biggest drawback of the material is that it cannot be resorbed from the canal before the resorption process of a deciduous tooth [16].
Zinc-oxide eugenol	Zinc- oxide eugenol paste can be used as root canal material and is best known for its anti-inflammatory and antibacterial properties of eugenol, but it is reported to have cytotoxic effects as well. According to some studies, eugenol causes foreign tissue reaction and osteonecrosis if eugenol is transmitted to periapical tissues. Another drawback of zinc-oxide eugenol paste is that it may cause damage to erupting permanent tooth and cause wastes in the tissue after the resorption of the deciduous tooth since it is not resorbed in accordance with root resorption of a deciduous tooth [17].
Iodoform	Iodoform overcomes the drawback of calcium hydroxide and zinc-oxide eugenol by resorbing in accordance with root as well as not causing harm to erupt permanent teeth. Sometimes the material resorbs more rapidly than the root making canals empty. Iodoform is antiseptic in nature, but excessive iodoform may replace the normal tissue quickly, and that it does not cause any foreign body reaction [17].
Calcium-hydroxide iodoform paste	The paste combines calcium hydroxide and iodoform to combine the positive features of each material. In combination, this material has many advantages such as it can be easily applied, having no toxic effect on the permanent teeth, high-level antibacterial activity, being able to resorb with roots and being a radio-opaque material, the material exceeding the canal to the periapical tissues are rapidly resorbed and does not form a hard body. Thus, it reduced the probability of the canal filling path to change the direction of the permanent tooth [16].
Calcium hydroxide-iodoform-zinc oxide eugenol paste	This paste combines zinc oxide eugenol, calcium hydroxide, and iodoform to overcome all the disadvantages of these materials. It is not resorbed in the canal, has antibacterial effects; the hydrophilic features make it suitable to use in wet canals [18].

Root canal treatment for deciduous teeth

Chronic inflammation and necrosis of deciduous teeth call for the root canal treatment to purify the canal from infection and to preserve the deciduous teeth in the mouth until they fall off normally with age with the eruption of permanent teeth. With the advancement in new techniques, imaging, and materials, root canal treatment in deciduous teeth can be made more feasible and less challenging. Digital imaging can be used over conventional radiographs because of their higher speed of imaging, image-saving abilities, and enabling changes on the images [19].

Apex finders can be useful, especially when radiographical imaging of the root apexes is blocked by anatomical structures. The other important advantage is not applying radiation to the patient and eliminating the need for time to process the film [20].

The stainless steel instruments usually used in root canal treatment show low flexibility, which leads to undesirable shapes in curvy canals. It also increases the risk of perforation. To overcome this problem, the Ni-Ti rotary files have been developed, which show high flexibility. The advantages of the Ni-Ti rotary system are as follow [21]:

1. Increase the cutting effectiveness of files
2. Facilitating the shaping of the curvy canals
3. Shortening the work time
4. Enables smoother canal surface and more conical shape
5. Simplifying the canal preparation procedure.

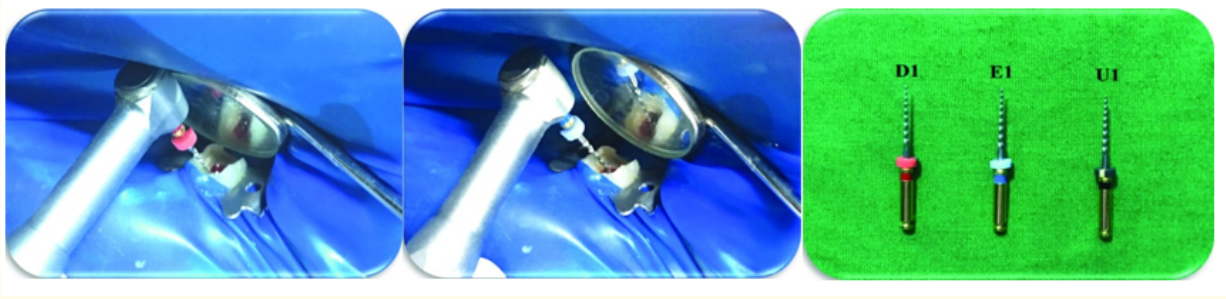

Figure 2: *Showing D1 and E1 rotary files in the second mandibular molar deciduous tooth as well as pediatric Ni-Ti rotary files - Red color-coded- 0.25 tips diameter, Blue color-coded- 0.30 tip diameter and Black color-coded- 0.40 tip diameter used for root canal preparation in primary teeth [22].*

Differences between root canal instrumentation and obturation in primary and permanent

The deciduous teeth are smaller than permanent teeth in all dimensions. The enamel and dentin thickness coronal to the pulp chamber is also thinner in a primary tooth. Therefore, utter care should be taken while making an access opening into the chamber so as prevent the perforation in the furcal area of the tooth. The anatomy of deciduous molars varies; the roots are divergent and curved in a way to allow the development of a succedaneous tooth. The chances of perforation of an apical portion or coronal one-third of the canal into furcation

during instrumentation increases due to the presence of these curves. Therefore, pre-curving of all instruments are necessary to reduce the possibility of perforation. Since the dentin walls of roots are thin, the flaring of the canal should also be kept to a minimum. This variation of root canal in deciduous molars makes it difficult to completely remove the necrotic tissue by instrumentation. To overcome this problem, profuse irrigation from sodium hypochlorite solution in a period of two appointments is strongly recommended to dissolve the necrotic tissues that are left behind after instrumentation [9,23].

The placement of instruments and filling materials beyond the radiographic apex must be avoided since over obturation and over instrumentation can possibly damage the tooth bud of permanent teeth, which is present just beneath the primary tooth. If the radiographs show visible resorption of the apex, then the working length should be kept 2 - 3 mm short of the radiographic apex. The long-cone paralleling technique is best used for accurately measuring the canal length. The root canal obturating material used in deciduous teeth must be absorbable so as to not affect the eruption of a permanent tooth because of this reason use of gutta-percha is contraindicated in deciduous teeth as a canal filler, with an exception where there is not succedaneous tooth present [9].

Pulpectomy and instrumentation

Following are the contraindication to root canal therapy in deciduous teeth [9]:

1. A non-restorable tooth
2. Pathologic root resorption involving more than one-third of the root
3. A tooth with a mechanical or carious perforation of the floor of the pulp chamber
4. The presence of a dentigerous or follicular cyst
5. Pathologic loss of bone support resulting in loss of the normal periodontal attachment
6. Radiographically visible internal root resorption.

Steps in root canal treatment

The pulpectomy procedure in anterior teeth is comparatively simple. The cleaning and shaping are done in the same manner as that of corresponding permanent teeth. The root canal is shaped after anesthetizing the tooth and post rubber placement [9].

Deciduous molars are more tricky for root canal treatment. After administrating anesthesia and placement of rubber dam, the access opening is done in a similar way as that of done for permanent molars, but care should be taken to not perforate the pulpal floor. Access is gained using a round bur, and post-removal of the maximal structure, the dentin ledges are removed, which is hindering the direct line access to the root canal orifice. The double-ended endodontic explored is used to explore and identify each canal. The pulpal chamber is irrigated with sodium hypochlorite copiously. The trial length is determined by measuring the tooth on pre-operative radiographs and subtracting 1 - 2 mm. After placing a small diameter file into the canal, the working length (WL) is determined using a radiograph taken with the paralleling technique in order to minimize distortions. The working length is kept 1 - 2 mm short of the radiographic apex [9].

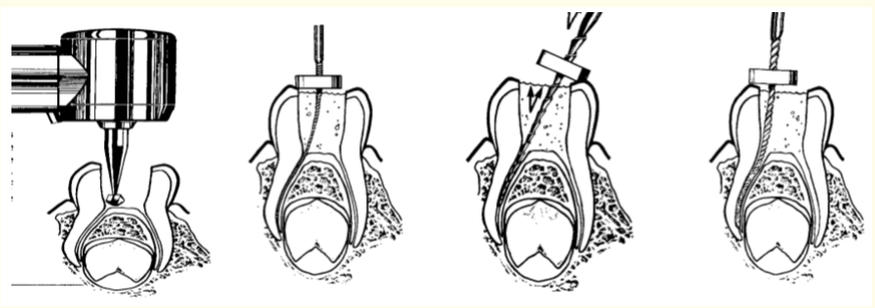

Figure 3: *Showing access opening using round bur and working length determination using a small diameter file [9].*

Once the WL has been determined, the cavity is copiously irrigated throughout canal preparation to avoid contamination to the underlying tooth bud; in case hemorrhage is encountered, it indicated the resorption has occurred, and working length should be shortened 2 - 3 mm from the radiographic apex. To flair the canal orifices, Hedstrom files may be used which are targeted towards the areas of the biggest bulk and away from the furcation to prevent stripping and perforation. Flaring of the canal is done a number of sizes past the size of the first file that fits snugly into the canal to a minimum final size of 30 - 35 and in such a way to receive root canal filling material. The canal is then dries using sterile paper points, sterile cotton is placed into the pulp chamber and sealed off temporarily in case intracanal medicament is used. In further appointment, the root canal is filled with an absorbable filling material such as Zinc oxide eugenol (ZOE) without a catalyst to ensure adequate working time during obturation [9,24].

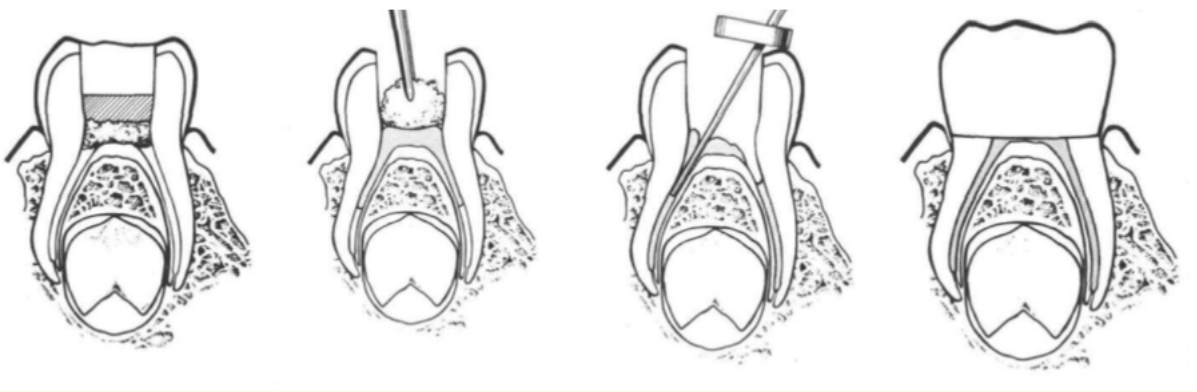

Figure 4: *Showing the placement of intracanal medicament using cotton pellet after blotting it, the use of cotton pellet as a plunger to force filling material down, an endodontic plugger or lentulo for the spread of the material, and a completely restored tooth post crown placement [9].*

To force down the filling material, a cotton pellet is used as a plunger and a #5-7 endodontic plugger or lentulo to fill material till apex. The adequacy of filling is checked by radiographs, and once the canals have been obturated, the tooth is restored permanently using a composite resin in anterior teeth and a stainless steel crown for posterior teeth. The patient should be recalled after 6 months to check and intercept any problem related to root canal treatment [9].

Conclusion

Despite so many advances in the protection of tooth from caries and widespread dentition protection awareness, the patients seeking pedodontics treatment keep on increasing due to early loss of deciduous teeth which possess many problems such as mesialization of permanent teeth, arc length loss, and ultimately malocclusions. Therefore, keeping deciduous teeth in the mouth by treatment is very important to ensure aesthetic and chewing functions, preventing the ectopic or early eruption of underlying permanent teeth, preventing the abnormal tongue habits created by positioning the tongue in the toothless cavity and thus negatively affecting speech. This can be achieve with appropriate endodontic treatment with the exploration and application of new materials and techniques in deciduous teeth.

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