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Intraradicular rehabilitation: A key to restore weakened tooth

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Abstract

Endodontic treatment further weakens the compromised tooth structure. To decrease the post-operative complication (e.g. root fracture), reinforcement of radicular dentin becomes requisite of endodontic treatment. Retention of fiber post system in excessively wide canal is compromised. The reinforcement of the canal can be done using composite resin with or without fiber post.

Keywords: Dentin reinforcement, fiber post, intraradicular rehabilitation, post-endodontic restoration

Introduction

Endodontically treated teeth lack sufficient tooth structure due to loss of coronal structure, recurrent caries extending into the root, developmental anatomy, internal resorption, iatrogenic damage during access opening, or flared canal. These compromised teeth can be restored by cast post and core or by placing the dentinal pins^[1]. If a tapered post is used to gain retention in a tapered canal, excess space can be taken up by a luting agent which will act as a potentially weak area resulting in less retentiveness of the tapered post^[2]. The teeth with severely damaged structures have a poor prognosis in a long run. However, extraction would not be a feasible treatment of choice for children. In such conditions, intraradicular rehabilitation can be done as an alternative treatment option. Intraradicular rehabilitation is an internal rehabilitation of root canal or root reinforcement by using MTA as an apical barrier and internal rehabilitation using composite resin without fiber post system.

Intraradicular rehabilitation incorporates two steps: (a) Sufficient apical seal, and (b) Root reinforcement. Apical seal can be obtained by different materials, such as gutta percha, bioceramic materials or calcium hydroxide induced apical barrier. Root reinforcement procedure can be carried out using different techniques that depends on the remaining tooth structure. Importance and the clinical steps for apical seal and root reinforcement is described in detail in the following section^[3].

Apical seal

Teeth indicated for intraradicular rehabilitation are frequently accompanied by a large communication between a root canal and periodontal ligaments due to over prepared canal, non-vital permanent teeth with wide open immature apex, and external root resorption. Irrespective of the etiology of a weakened root, emphasis should be on the achievement of the apical seal during root canal therapy. One of the techniques to achieve biological seal is apexification. It is the technique that induces apical closure by the formation of mineralised tissue. It can be performed in a single visit (MTA apexification) or multiple visits (calcium hydroxide)^[4].

Calcium phosphate ceramics, freeze-dried cortical bone, freeze-dried dentin and dentinal shavings have been tried as apical barriers in single visit apexification. However, these materials are largely used in experimental studies but are not being used commonly in clinical practice. In clinical practice, bioceramic-based material such as MTA or biodentin can be used as an apical barrier. These materials can be used even when the apical diameter is 0.7 mm.

They showed higher clinical success due to stimulation of cytotoxicity, increased production of interleukin, and hard tissue formation [5].

Clinical steps

An apical plug can be placed either in one visit or two visits. The tooth to be treated should be isolated using a rubber dam or other alternatives. The canal should be thoroughly shaped and cleaned using sodium hypochlorite, 17% ethylenediaminetetra acetic acid, or 10% citric acid. The paper point should be used to dry the canal. The diameter and the length of the paper point should be adequate to not inadvertently damage the periapical tissue, causing trauma or hemorrhage. To avoid this, larger-sized paper points which are measured to correct working length could be used [6].

In the procedure where the apical plug placement is single sitting is planned, bioceramic material should be placed in apical 4-5 mm after drying the canal [7, 8]. In other situations, where the apical plug formation is carried out in two visits, calcium hydroxide should be placed as an intracanal medicament to disinfect the canal and to induce the hard tissue formation at the apical area. The patient should be recalled after 3 months. However, this duration depends on the type of calcium hydroxide used for the particular case. Calcium hydroxide with aqueous formulation requires multiple visits to induce the hard tissue formation whereas calcium hydroxide in oil vehicle can be replaced after 3 months [9-11].

During the second visit, calcium hydroxide should be removed using a chelating agent and saline. Hard tissue formation should be evaluated clinically and radiographically [12]. If it is not formed, MTA can be used as an alternative to forming an apical barrier using a dovgan carrier. Condensation should be carried out using Buchanan plugger with gentle apical tapping. Rubber stop can be used to control the condensation within 1 mm of the working length [10].

An apical barrier of 4-5 mm is sufficient for satisfactory apical sealing and to resist displacement. The moist cotton palate should be placed and the tooth should be restored temporarily. The patient should be recalled after 24 hours for the root reinforcement procedure [3].

Root reinforcement

Root reinforcement should be performed to increase the resistance of the remaining thin root dentin which is more prone to root fracture. In 1994, Lui recommended a technique in which the canal should be etched, dried, and bonded using adhesive resin. The canal should be lined with chemically cured composite resin followed by cementation of the parallel-sided metal post should be carried out. However, the polymerisation reaction cannot be controlled in the apical portion of the root canal in this technique [2]. This can be replaced by using light-cured composite resin but it could have limited curing depth (4-5 mm) which may lead to unpolymerised resin in the apical area resulting in a weakened seal between the apical plug and composite resin [13].

To overcome these problems, plastic, clear, and light-transmitting posts can be used which allows the transmission of light along the entire post length. It permits polymerisation of composite resin to the entire length and circumference of post space preparation. As an alternative, smooth, parallel-sided with the pointed tipped post can be used to patent the canal space which can be further restored with a size-

matched, passive, parallel-sided, metal post system. The purpose of this technique is to retain a core and crown because this does not strengthen the root itself. Potential to increase the reinforcement of root dentin depends on the thickness of composite resin bonded to the internal aspect of the canal. The smaller the diameter of the post, the lesser the transmission of light to the apical part resulting in decreased depth of cure. This technique improves the fracture resistance by 50% than those without composite resin reinforcement (Trope M, 1998) [2, 14].

Earlier, smooth parallel-sided metal posts were used to accomplish this purpose which is replaced with a quartz fiber post system. Quartz fiber posts can be used when there is insufficient coronal tooth tissue, post is required to retain a tooth-colored core or full ceramic crown. It reduces the "shine through" effect of the metal post system. Due to more flexibility, there is less stress transmission to the weakened root area [14, 15].

Techniques

1. Intraradicular rehabilitation without post

It is indicated when sufficient coronal tooth structure is present, and no post is required to gain retention form the root canal. After placement of apical plug, the patient is recalled after 24 hours. Once MTA is set, select the appropriate size of fiber post. The diameter should be smaller than the canal width to allow an adequate volume of composite resin to surround it. Length should be controlled by placing the rubber stop.

The canal should be etched and washed thoroughly with saline to remove the remnants. To dry the canal following etching, paper points can be used. Choice of adhesive can be applied and light-cured. After placing composite resin into the canal, the fiber post should be placed centrally into the canal to its full length. Vaseline should be applied to the surface of post for easy retrievability after curing. The post should be removed from the canal after light curing. Following this, the access cavity should be restored with composite resin [3].

2. Intraradicular rehabilitation with post

It is indicated when sufficient coronal tooth structure is not present, and post is required to gain retention form the root canal. In such situations, the choice of post system is a quartz fiber post. Root reinforcement should be done in the same way as the above-mentioned condition, with composite resin. After obtaining the patent canal by removing the post, the appropriate size of quartz fiber post should be selected. An appropriate twist drill should be used to modify the post space. The larger-sized drill should be used to remove the superficial layer of cured contaminated composite to remove vaseline which may further interfere with bonding. The selected post should be evaluated for fitting to the prepared canal. Surface treatment of the post should be carried out based on a selection of an adhesive system. Chemically or dual-cured resin cement can be used to cond the post. However, the selection of resin cement depends on the surface treatment of the post. If self-etch adhesive is used to treat the post system, self-cured resin cement should not be used as a luting agent to reduce resin incompatibility. After luting of the post system, core should be contrasted using composite resin [16]. Case reports on intraradicular rehabilitation using different techniques have been reported in the literature (Table 1) [17-20].

Table 1: Case reports on intraradicular rehabilitation using different techniques have been reported in the literature

Author, year	Tooth number	Technique used	
		Apical Seal	Root reinforcement
Duarah M, Vimala N, Mandke L.; 2015	Maxillary right and left central incisor	MTA plug <i>PRO ROOT® MTA</i> (Dentsply/Tulsa Dental, Tulsa, OK)	Fiber post <i>PARACORE®</i> (Coltene/Whaledent)
Gade P, Gade HS, Gade N.; 2016	Maxillary right central incisor	MTA plug + 2 mm of thermoplasticized gutta percha	Fiber post + nanohybrid composite
Lakhera H, Mantri VR, Palekar A, Raut AW.; 2016	Maxillary right central and lateral incisor	MTA plug	Luminex esthetic post system (<i>Dentatus Dental Products, New York, USA</i>) + Dual cure flowable composite resin (<i>Paracore, Coltene/ Whaledent Products, Cuyahoga Falls, Ohio, USA</i>)
Khatter R, Bal CS, Singh RD, Walia S.; 2010	Maxillary left central incisor	Gutta percha	GIC TYPE IX + custom made post and core

Conclusion

MTA can be used as an alternative to form an apical plug or barrier in clinical condition. Thermoplasticized gutta percha does not strengthen the teeth with wide canal. If these teeth require post retained crown, the chances of root fracture following restoration increase drastically. Incorporation of MTA as an apical barrier can be used and intracanal rehabilitation of root canal with composite resin can be done to prevent such fractures.

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