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Endodontic obturation techniques: A review

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Abstract--Obturation in endodontics is one step which is of utmost importance. For success of endodontic process a tight seal should be achieved which is necessary for successful treatment. Over the past few years, advanced obturation materials and techniques have been introduced for endodontic therapy. Among the different obturating materials available, gutta percha is one of the most widely used. Various techniques available for condensing gutta percha are available. Newer devices are being introduced some of which are heat, injection, vibration, compaction & carrier based systems. This article aims to present the different techniques available for root canal filling materials.

Keywords---Gutta-percha, thermoplastic, injection, technique, heat.

Introduction

Success of endodontic therapy is dependent on many factors including proper diagnosis, treatment planning, knowledge of canal anatomy and morphology, debridement and obturation of root canal. Obturation is the process of three-dimensional filling of entire root canal system with the help of root canal sealers to establish an adequate seal".[1] Clinician should always follow protocols which result in complete cleaning & shaping of the root canal system in along with obturation technique which provides a 3-D seal, apically, laterally, and coronally within the confines of the root canal system.

The aim of endodontic treatment is thorough debridement and cleaning of the root canal system of any infected pulp tissue so the canal space can be shaped and prepared to be filled with an inert material thus preventing or minimizing any chances of reinfection. However, failure ensues when the endodontic treatment falls short of the standard clinical principles.[2]

The American Association of Endodontics defines root canal obturation as "the three dimensional filling of the entire root canal system as close to the cementodentinal junction as possible".[3] An inadequate root filling is a

contributor among other factors [4–7]. It has been demonstrated that bacteria are a primary cause of endodontic treatment failure [8–11].

Many materials and techniques have been developed for obturation since the last few years. However, gutta-percha is the most commonly used material using cold or warm techniques. Root canal anatomy includes auxiliary canals, loops and fins which are often difficult to obturate. Various obturation methods have been developed in the recent years.

Root canal anatomy includes auxiliary canals, loops and fins which are often difficult to obturate. To protect against apical and coronal leakage, which are frequently causes of failure, a three-dimensional obturation of the root canal system is essential. Thus the thermoplasticized obturation systems were introduced to overcome the drawbacks of the cold condensation techniques. Based on the technique used thermoplasticized obturation systems can be classified under two categories Injection systems and Carrier based systems. In the injection technique the heating of gutta-percha outside the tooth and the material is injected into the canal. The Obtura III, Calamus, Elements HotShot, and Ultrafil3D are among the available devices. The concept of a carrier-based thermoplasticized gutta-percha obturation method was introduced by Johnson in 1978. These products are marketed today as Thermafil, GT Obturators, GT Series X Obturators, ProTaper Obturators, Densfil and Soft-Core, Three Dee GP. While the benefits of using thermoplasticised obturation includes a better three dimensional obturation including the filling of accessory canals the major drawbacks include the high cost of usage and equipments required, the shrinkage of gutta percha on cooling and the negative effects of heat on the surrounding periodontal tissues.

Thus, the aim of this review article is to critically review the currently available various methods used for the obturation of root canal systems in endodontics with special emphasis on the thermoplasticized techniques of root canal obturation.

Objectives of Obturation

Schilder described the final objective of endodontic procedures as being “the total obturation of the root canal space.” He also stated, “in the final analysis, it is the sealing of the complex root canal system from the periodontal tissues that ensures the health of the attachment apparatus against breakdown of endodontic origin.” A three dimensional obturation of the radicular space is essential for long term success of root canal treatment. The canal should be sealed apically, coronally and laterally although various methods have been used for obturation all of them result in some degree of leakage. [12]

A root canal may be obturated when the canal is cleaned and shaped to an optimum size and taper. The tooth should be asymptomatic and canal should be dry. Dry canals may be obtained with absorbent points except in cases of apical periodontitis or apical cyst, in which “weeping” into the canal persists. Ideal root canal treatment should seal all “portals of exit” to prevent any sort of communication between the root canal system and periodontium. This can be

achieved by cleaning and shaping of entire root canal system and its three dimensional obturation to prevent microorganisms from re-infecting the root canal system thereby preventing tissue fluids percolating back into the root canal system.

Requirements of an Ideal Obturation Technique

An ideal obturation technique should have the following properties. [13]

- 1) It should result in a dense homogeneously compacted mass of gutta-percha with perfect replication of the canal system.
- 2) It should fill all irregularities of canal system leaving minimal voids.
- 3) It should have minimal post-operative contraction.
- 4) It should be safer with minimal chances of peri apical extrusion, root fracture against condensation forces and periodontal safety against thermal changes.
- 5) It should be faster and easier to learn and practice.

The best obturation technique is the one that gives us the best clinical outcome for our treatment, simple to use in all types of cases, faster, with minimal complications and with easier learning curve for new users. The problem is that determining which obturation technique yields the best clinical outcome with highest success rate becomes very difficult, because there are so many variables which can affect the outcome of treatment. There are many different obturation techniques but no single technique has been identified which is superior in all aspects.

Techniques of Obturation

1. lateral condensation technique

It is the most widely used obturation technique [14] but three dimensional seal is not achieved. Its main advantage is guttapercha in the root canal which can be controlled and being cost effective. The final obturated canal has a large number of gutta percha cones condensed together.

Limitations

Main drawback is voids and spaces in the final condensed which could be due to poor condensation and anatomic variations like curvature of canals. [15]

2. Warm Compaction

A. Warm Vertical Compaction

Principle

The technique of filling root canals was given by **Schilder**. [16] Its main objective to fill the root canal with the help the application of vertical pressure using heated pluggers which help softened gutta percha.

Indications

Its main indication is presence of ledges, curvatures, resorptions in the canal.

Method

In this technique after coating the canal with sealer the primary master cone is inserted till the working length. After removing the coronal part of the cone, a “heat carrier,” such as a root canal plugger which is red hot is inserted in the canal coronally. Electric heat carriers like Touch n Heat (SybronEndo; or System B (SybronEndo; can also be used as they help in controlling temperature. Using a plugger vertical pressure is applied to the heated gutta-percha to causing the plasticized material to flow apically. Until the canal is completely sealed this process is repeated.

Advantages

Complete sealing of the canal three dimensionally and sealing of lateral and accessory canals.

Disadvantages

Its main disadvantage is risk of overfilling and vertical root fracture 17 by condensation force and the process being time consuming.

B. Warm Lateral Compaction

Main advantage of this technique is ability to control length during obturation process. Master cone is inserted and compacted laterally using heat carriers such as *Endotec II tips* (Medidenta) and *EndoTwinn tips* (Hu-Friedy). [18] This process is repeated done till the canal is filled completely.

3. Continuous Wave Compaction Technique

This technique was given by Buchanan. It permits use of tapered nickel- titanium systems to prepare the canal. It uses system B with stainless steel pluggers #.06, #.08, #.10, and #.12 is done according to the size of the shaping instruments. The process uses heat carrier system to fill the spaces left using thermoplastic injection technique (Obtura II or Ultrafil 3D [Coltène/Whaledent], Calamus [DENTSPLY Tulsa Dental Specialties], Elements [SybronEndo, Orange, CA], or HotShot [Discus Dental, Culver City, CA])

4. Thermoplasticized Injection Techniques

In this technique in which Heated gutta-percha is injected in the root canals It uses devices like Obtura III, Calamus, Elements, HotShot, and Ultrafil 3D for this purpose.

Obtura III

This technique uses Obtura III (Obtura Spartan; The Obtura III causes heating of gutta percha to 160-200°C in a gun that has a heating element having gutta percha pellets surrounding a chamber. [19] After the canal walls are dried and coated with sealer, Gutta percha is injected with the help of the gun with a selected gauge of needle 20, 23 or 25 which is short of the working length by 3-5mm. Gradual withdrawal of needle is done until the apical fill of canal is complete

using pluggers compaction of gutta percha is done. The remaining canal is usually filled incrementally with the same process.

Limitations

One major limitation is difficulty of controlling the length causing overextended or underfilled canal fillings. A study comparing lateral compaction with Thermafil (DENTSPLY Tulsa Dental Specialties) and Obtura II in root canal models concluded that adaptation to the canal walls was best in Obtura II. 20

Ultrafil 3D

Another thermoplasticized compaction technique is Ultrafil 3D (Coltène/Whaledent) which consists of heating unit, injection syringe and gutta-percha cannulas of three types regular set, firm set and endoset. Cannula has a 22-gauge stainless steel needles which are 21mm in length. The gutta-percha from the needles can flow for 45- 60 seconds.

Calamus

Calamus thermoplastic obturation system (DENTSPLY Tulsa Dental Specialties) is a specialized device having cartridge which have 20 and 23-gauge needles. The system can temperature control and controlled rate of flow. Different Pluggers are used for use with this unit.

Elements

Elements obturation system (SybronEndo) has a handpiece for delivery of plasticized gutta percha, System B heat source and a plugger. The cartridges have 20-, 23-, and 25-gauge needles for gutta-percha and for Real Seal 20- and 23-gauge cartridges.

HotShot

Another thermoplastic device is HotShot delivery system (Discus Dental) which is cordless its range of heating is 150-230° C which can be used with both gutta-percha and Resilon. It consists of Needles in sizes of 20, 23, and 25 gauges.

GuttaFlow

GuttaFlow (Coltène/Whaledent) has matrix of polydimethylsiloxane which is filled with gutta-percha. The material is available in capsules. The working time of material is 15 minutes and its curing is done in 25-30 minutes. Sealing ability appears comparable to other techniques in some studies and inferior in others.21-24

5. Carrier-Based Gutta-Percha

Thermafil, Profile GT Obturators, GT Series X Obturators, and ProTaper Universal Obturators

This technique is based on the principle of thermafills which is an alpha phase gutta-percha coated with a plastic core carrier. They are available in different sizes and tapers and can be used according to the size of canal prepared. The use of thermafills requires a device used for heating.

After the canal is dried and sealer is applied on the walls, verified heated thermafil carrier is placed inside the canal after radiographic confirmation the coronal part of the carrier is seared off. The use of sealer such as AH Plus is necessary in this technique.

Advantage of this technique is its easy placement and that gutta percha fills the lateral and accessory canals. The main disadvantage is difficult to control length and postoperative pain.

SimpliFill (LightSpeed Technology, San Antonio, TX/Discus Dental)

SimpliFill is another carrier based sectional gutta-percha obturation technique used after preparing the canal with LightSpeed instruments. The canal walls are coated with AH Plus sealer. The selected carrier does sectional obturation of the root canal and its shaft is separated from the apical part of gutta percha by anticlockwise rotation. Size of the carrier is according to the diameter of the master apical file. The remaining canal space is filled with lateral or thermoplasticized gutta-percha techniques. This is an efficient technique and its leakage is same as of other techniques.[25]

6. Thermomechanical Compaction

McSpadden Compactor device was introduced by McSpadden, consists of flutes which are same as of a Hedström file but are in reverse order. The instrument when rotated in a hand piece causes softening of gutta percha. In this technique sealer is applied and master cone is fitted short of the length prepared. A selected compactor is inserted along with the gutta-percha cone. Gutta-percha is heated by activation of handpiece and then compaction is done laterally and in apical direction.

Advantages are technique has simple armamentarium, fills irregularities of canal. Disadvantages are possibility of material extrusion, fracture of instrument, generation of heat and this technique cannot be used in curved canals.

7. Chemically Plasticized Gutta-Percha Technique

Solvents like chloroform, eucalyptol, and xylol are used for gutta percha plasticization. Disadvantages shrinkage, voids, material extrusion and periradicular tissues irritation.

8. Conclusion

Successful endodontic therapy requires location of all canals, efficient cleaning and shaping, disinfection of canals and three dimensional sealing of canals to eliminate all portals of entry between the root canal and periodontium. A good seal leads to good prognosis of the tooth. Studies have concluded that inadequate obturation causes microbial growth and reinfection in the canal spaces. Complexity of the root canal system causes this process of complete sealing of canals challenging. Different materials and techniques have been used for obturating the canal, but ideal filling requires to be completely compacted and to adhere to shape of walls of the canal, and it must seal upto the juncture of periodontium and the root canal. Thus it can be concluded that the technique used for obturating a canal should be selected taking into consideration a number of factors including the canal shape type and curvature of canal.

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