ISSN : 2350-0743

www.ijramr.com

International Journal of Recent Advances in Multidisciplinary Research
Vol. 03, Issue 12, pp.2038-2042, December, 2016

RESEARCH ARTICLE

RECENT ROOT CANAL FILLING MATERIALS AND TECHNIQUES - A REVIEW

***Mohd.Mustajibuddin Khatib, Bhondwe Sarvesha, Mahajan Vishal, Rohit Dhoot and Kuldeep Rana**

Department of Conservative Dentistry and Endodontics, Yashwantrao Chavan memorial medical and rural development foundation's dental college and hospital- Ahmednagar-414003

ARTICLE INFO

Article History:
Received 15th September, 2016
Received in revised form
25th October, 2016
Accepted 20th November, 2016
Published online 30th December, 2016

Keywords:

Gutta-percha, Obturating material, Obturating technique, Obturation.

ABSTRACT

Obturation is the most important step in the triad of endodontics. Carefully and properly achieved obturation will lead to the formation of "fluid tight seal" which is essential for the success of the endodontic treatment. Over the past decade, the science & practice of root canal therapy has changed dramatically on evidence based protocols to develop highly advanced obturation materials and techniques. Gutta percha with sealer is the most versatile obturating material. But it has very big disadvantage that it does not bond to the root canal dentin. To overcome this drawback, bonded resin materials where developed. Many parelling techniques, materials where developed to improvise the obturation of the root canal. They include heat, injection, vibration, compaction & carrier based system. In this article all the root canal filling materials and techniques available at present are discussed.

INTRODUCTION

The success of root canal treatment depends upon proper diagnosis and treatment planning, Knowledge of canal anatomy and morphology, canal debridement, sterilization of canal and Obturation. Root canal obturation is defined as "the three- dimensional filling of the entire root canal system as close to the cementodentinal junction as possible. Minimal amounts of root canal sealers are biologically compatible, are used in conjunction with the core filling material to establish an adequate seal". (American Association of Endodontists, 1994) Clinician should choose a path of treatment that will result in best possible cleaning & shaping of the root canal system, coupled with an obturation technique that will provide a 3-D seal, apically, laterally, and coronally within the confines of the root canal system. We have progressed in endodontic obturation to realize that the sealer is the key to obtaining a true fluid tight seal. The challenge, more specifically, has been to find a sealer that would simultaneously bond to the canal wall as well as to the gutta-percha cone or a similar core material. Endodontic science has realized that if it could satisfy such a challenge, we would then have the possibility of creating a true monobloc. Root canal filling materials and techniques have advanced dramatically in the last two decades. Traditionally, gutta percha point combined with sealer has been the obturation of choice. Gutta percha is versatile, with a long history of use, but the drawback of gutta percha is it does not bond to root canal.

****Corresponding author: Mohd.Mustajibuddin Khatib,***
Department of Conservative Dentistry and Endodontics, Yashwantrao Chavan memorial medical and rural development foundation's dental college and hospital- Ahmednagar-414003

Techniques for obturating root canals include the use of heat or chemically-softened gutta percha, injection techniques, ultrasonics, vibration and carriers. Carrier based materials are available that utilize a core carrier around which obturating material is coated. The introduction of bonded obturating materials (methacrylate resins) has enabled the clinician to obtain a bonded seal to the root canal dentin in areas reached by the etch/adhesive materials. In addition, a carrier-based system is now available that combines a carrier technique and adhesive technology for bonded obturation. In this article, root canal filling materials and techniques will be discussed (Richard Mounce).

Historical Background

Before 1800 root canal filling, when done, was limited to gold. Subsequent obturations with various metals, oxychloride of zinc, paraffin, and amalgam resulted in varying degrees of success and satisfaction. In 1847, Hill developed the first gutta percha root canal filling material known as "Hill's stopping" (Koch and Thorpe, 1909). The preparation, which consisted principally of bleached gutta percha and carbonate of lime and quartz, was patented in 1848 and introduced to dental profession. In 1867, Bowman made claim (before the St. Louis Dental Society) of the first use of gutta percha for canal filling in an extracted first molar (History of Dentistry in Missouri, 1938). In 1883, Perry claimed that he had been using a pointed gold wire, wrapped with some soft gutta percha (Perry, 1883). In 1887, the SS White company began to manufacture gutta percha points. In 1893, Rollins introduced a new type of gutta percha to which he added vermilion (Weinberger, 1948). The softening and dissolution of the gutta percha to serve as the cementing agent, through the use of rosins, was introduced by Callahan in 1914.

Gutta Percha

Gutta percha is the preferred choice as a solid, core filling material for canal obturation. It demonstrates minimal toxicity, minimal tissue irritability, and is the least allergenic material available when retained within the canal system (Nguyen, 1994). The successful use of the curious material gutta percha seems to have been as insulation for undersea cables. This was in 1848, and patents followed for its use in the manufacture of corks, cement thread, surgical instruments, garments, pipes, and sheathing for ships. Gutta percha golf balls were introduced by the latter part of the 19th century; until 1920, golf balls where called "gutties" (Goodman *et al.,* 1974). In its pure molecular structure, gutta-percha is the trans-isomer of polyisoprene and has an approximately 60% crystalline form. The cis-isomer is natural rubber, which has a largely amorphous form. Gutta-percha has three possible phase changes. In the unheated tree or in the cone at room or body temperature, gutta-percha is considered to be in the beta phase. In this phase, gutta-percha is solid, compactible, and elongatible; may become brittle when aged; and does not stick to anything. When heated to temperatures of 420 to 49 0C, gutta-percha undergoes a phase change to the alpha phase. In this phase it is runny, tacky, sticky, noncompactible, and non elongatible. The third, or gamma phase, occurs when heating is raised to 560 to 62 0C, but the properties at this level are not well known and seem to be similar to that of the alpha phase. The significance of these phases, in addition to the changes in physical properties, is that the materials expand when heated from the beta to the alpha or gamma phases, from less than 1% to almost 3%. When cooled down to the beta phase, a shrinkage takes place, of similar percentiles, but the degree of shrinkage almost always is greater than the degree of expansion and may differ by as much as 2%. That means that if gutta-percha is heated above 420 to 490 C (1080 1200 F) and then inserted into a prepared canal, a condensation procedure should be applied or some method used to lessen the problem of shrinkage.

Constituents of commercial gutta-percha cones

Material	Percentage	Function
Gutta-percha	18-22	Matrix
Zinc oxide	59-76	Filler
Waxes/resins	1-4	Plasticizer
Metal sulfates	1-18	radiopaque

Different types of gutta percha availability

- **Gutta percha points:** They have size and shape similar to ISO standardization.
- **Greater taper gutta percha:** They have taper other than 2%. They are available in 4%, 6%, 8% and 10 % sizes.
- **Auxiliary points:** They are non-standardized gutta cones. They perceive the shape of root canal.
- **Precoated gutta percha:** Metallic carriers are coated with gutta percha. Carriers used are stainless steel, titanium, or plastic materials. Eg: Thermafill.
- **Gutta flow:** In these powdered gutta percha is incorporated in resin based sealer.
- **Syringe system:** Here low viscocity gutta percha is used. Eg: Successfil
- **Gutta percha pellets/bars:** Available in small pellets and are used for thermoplasticized gutta percha obturation. Eg: Obtura system.
- **Gutta percha sealers:** Gutta percha is dissolved in chloroform or eucalyptol to be used in the canal.
- **Medicated gutta percha:** calcium hydroxide, iodoform or chlorhexidine containing gutta percha points.

Resilon

Resilon™, a new, synthetic resin-based polycaprolactone polymer has been developed as a gutta-percha substitute to be used with Ephiphany®, (Pentron® Clinical Technologies, Wallingford, CT.) a new resin sealer in an attempt to form an adhesive bond at the interface of the synthetic polymer-based core material, the canal wall and the sealer. Advocates of this technique propose that the bond to the canal wall and to the core material creates a "monoblock." It is capable of being supplied in standardized ISO sizes and shapes, conforms to the configuration of the various nickeltitanium rotary instruments, and is available in pellet form for injection devices. The manufacturer states that its handling properties are similar to those of gutta-percha and therefore it can be used with any obturation technique. Resilon contains polymers of polyester, bioactive glass and radiopaque fillers (bismuth oxychloride and barium sulfate) with a filler content of approximately 65% (Lofti). It can be softened with heat or dissolved with solvents like chloroform. This characteristic allows the use of various current treatment techniques. Being a resin-based system makes it compatible with current.

Smartseal

In recent years, the field of endodontics has taken major strides in various aspects, be it the operating microscope or a wide range of file systems and irrigation regimens. Despite these several advances, the materials and the methods of obturating root canal have not significantly changed. In a study performed to investigate current endodontic clinical practice among 702 primary care dentists in the north west of England, it was found that lateral condensation technique was the popular obturation method among majority of them (Palmer *et al.,* 2009). This product is considered to exhibit smart behavior and incorporates developments in hydrophilic polymer plastics. Smartseal is a two-part system consisting of:

- Propoint
- Smartpaste/Smartpaste Bio

Propoint

Also known as C points, these obturation points are constructed in two parts:

Central Core

It consists of a combination of two proprietary nylon polymers, Trogamid T and Trogamid CX. It is considered to provide the point with the flexibility to allow it to easily pass around any curves in the prepared canal, while being rigid enough to pass easily to length in narrower canals.

Outer Polymer Layer

It consists of a cross-linked copolymer of acrylonitrile and vinylpyrrolidone, which has been cross-linked using allyl methacrylate and a thermal initiator. This hydrophilic, hydrogel layer allows the point to swell in order to adapt to the ramifications of the root canal. This coating is designed to swell laterally, thereby self-sealing the canal. It does not swell axially so there is no length change and radial swelling stops once a seal is created (Smartseal DRFP Limited, 2012).

All tip sizes and it is available in the following sizes:

6% taper - ISO tip sizes 25 to 45
4% taper - ISO tip sizes 25 to 45
ProTaper™ - F1, F2, F3, F4 & F5
Sendoline™ S5 - S2, S3, S4. (Figure 1)

Figure 1. Propoints: S range

Smartpaste

Smartpaste is a resin based sealer containing an active polymer that swells to fill any voids or cavities in the root canal. The degree of swelling is controlled by the amount of active polymer used. The polymer can also swell at a later date to fill any voids that might develop. It is dispensed in a syringe to ensure an accurate ratio of sealer components is achieved every time and mixing/dispensing trays are provided to aid application created (Smartseal DRFP Limited, 2012).

Obturation Techniques

Lateral Compaction

A master cone corresponding to the final instrumentation size and length of the canal is coated with sealer, inserted into the canal, laterally compacted with spreaders and filled with additional accessory cones.

Advantages: It can be used almost all clinical situations, it provides length control and thus overfilling is avoided.

Disadvantages: It may not be able to fill the canal irregularities efficiently, it does not produce homogenous mass and thus spaces may be present in between the cones.

Tailor made gutta percha technique

Tailor made gutta percha is prepared by joint multiple gutta percha cones from butt to tip until a roll is formed. Then this roll is softened by using ethyl chloride spray. For use in the canal, the outer surface of tailor made cone is dipped in chloroform, eucalyptol or halothane and then cone is placed in the canal. For complete obturation of blunder bus canals, tailor made gutta percha or warm gutta percha technique is preferred (Guttman and Heton, 1981)

Vertical Compaction

A master cone corresponding to the final instrumentation size and length of the canal is fitted, coated with sealer, heated and compacted vertically with pluggers until the apical 3-4mm segment of the canal is filled. Then the remaining root canal is back filled using warm pieces of core material.

Advantages: Excellent sealing of canal apically, laterally and accessary canals.

***Disadvantages*:** Vertical root fracture, overfilling and time consuming

Warm Lateral

A master cone corresponding to the final instrumentation size of the canal is coated with sealer, inserted into the canal, heated with a warm spreader, laterally compacted with spreaders and filled with additional accessory cones. Some devices use vibration in addition to the warm spreader (Togger *et al.,* 1984).

Lateral / Vertical Compaction of Warm Gutta Percha Technique

Lateral compaction provides length control whereas vertical compaction provides dense obturation. So advantages of both these techniques are provided newer devices Endotech II. It comes with battery which provides energy to heat the attached plugger and spreader (Togger *et al.,* 1984).

Sectional Method

It is also called as Chicago technique and promoted by Coolige, Lundquist, Blany.

***Advantages*:** It selas the canals apically and laterally. If post core is planned only apical section of canal is filled

Disadvantage: Time consuming and difficult to remove the sections of gutta percha if there is overfilling.

Figure 2. Sectional technique

Mac-Spadden Compaction

It is also called as thermomechanical compaction of gutta percha and it is introduced by Mac-Spadden. In this technique heat was used to decrease the viscosity of gutta percha. It uses Mac-Spadden compactor which resembles reverse hedstrom file. A cone coated with sealer is placed in the root canal, engaged with a rotary instrument that frictionally warms, plasticizes and compacts it into the root canal (O'Neill, 1983).

Obtura II (Obtura Spartan, Earth City, Mo.)

Introduced in 1977 at Harvard Institute. It consists of an electric control unit with pistol grip syringe and specially designed gutta-percha pellets which are heated to approximately 365 – 3900F(185-200 0C) for obturation. Canals should have continuous tapering funnel shape smooth flow of softened gutta-percha. Obtura II is indicated in roots with straight or slightly curved canals and also used in cases of obturation of roots with internal resorption or perforations (Evans, 1986).

Figure 3. Obtura II

Thermafil

Introduced by W.Ben Johnson in 1978. Thermafil endodontic obturators are specially designed flexible steel, titanium or plastic carriers coated with alpha phase gutta-percha.

Advantages: It provides dense three dimensional obturation and fills the canal irregularities like fins, anastomoses and lateral canals. Less strain is required during obturation.

Figure 4. Thermafil

Fiberfill Obturator

This obturation technique combines a resin post and obturator forming a single until and apical 5-7 mm of gutta-percha. This apical gutta-percha is attached with a thin flexible filament to be used in moderately curved canals. Its advantage includes less coronal microleakage.

Figure 5. Fiberfill Obturator

Conclusion

To achieve the successful endodontic therapy, it is crucial that all canals are located, cleaned & shaped, disinfected & sealed properly, not only in the apical portion but as well as coronal part of the root canal. Clinician should choose the obturating material & technique depending on the skills, experience and the situation of the root canal morphology. The one who selects the appropriate root canal filling material and uses the appropriate root canal filling technique, so as to completely seal the root canal will be remembered throughout the patients life through his competent work done on the patient tooth.

REFERENCES

American Association of Endodontists: Glossary, contemporary terminology for endodontics, ed 6, Chicago, The Association, 1994.

Callahan, J.R. 1914. Rosin, solution for the sealing of the dental tubuli and as an adjuvant in the filling of the root canals, *Allied Dent J.,* 9(53):110.

Evans, J.T., Simon, J.H.S. 1986. Evaluation ofo the apical seal produced by injected thermoplasticized GP in the absence of smear layer & root canal sealer. JOE, 12:101.

Goodman, A., Schilder, H., Aldrich, W. 1974. The thermomechanical properties of gutta percha. II. The history and molecular chemistry of gutta percha. *Oral Surg.,* 3:954.

Guttman, J.L., Heton, J.F. 1981. Management of the open apex II: Non-vital teeth. IEJ, 14:173.

History of Dentistry in Missouri, Fullton, Mo, 1938. The Ovid Press, Inc.

Koch, C.R.E., Thorpe, B.L. 1909. A history of dental surgery, vols 2 & 3, Fort Wayne, Ind, National Art Publishing Co.

Lofti, M. Resilon; A comprehensive literature review. JODDD, 7(3), 119-131.

Nguyen, N.T. 1994. Obturation of the root canal sysytem. In Cohen S, Burns RC, Editors: Pathways of the pulp, Ed 6, St. Louis., Mosby, 219-271.

O'Neill, K.J. 1983. Evaluation of the apical seal produced by McSpadden compactor & lateral condensation with a chloroform softened cone. JOE, 9:190.

Palmer, .NO.A. et al. 2009. An investigation of current endodontic practice and training needs in primary care in the north west of England. *British Dental Journal*, 206(11):22-25.

Perry, S.G. 1883. Preparing and filling the roots of teeth, Dent Cosmos. 25:185.

Richard Mounce, E. Current Philosophies in Root Canal Obturation, www.ineedce.com.

Smartseal DRFP Limited, 2012. http://www.smartseal.co.uk/how-it-works

Togger, M. 1984. Evaluation of the apical seal produced by a hybrid root canal filling method, combining lateral condensation and thermatic compaction. JOE, 10:299.

Weinberger, B.W. 1948. An introduction to the history of dentistry, St. Louis, Mosby.

****