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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/18593
DOI URL: http://dx.doi.org/10.21474/IJAR01/18593

RESEARCH ARTICLE

OBTURATION AND DIFFERENT OBTURATION TECHNIQUES- A REVIEW

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Manuscript Info

Manuscript History
Received: 26 February 2024
Final Accepted: 30 March 2024
Published: April 2024

Abstract

The crucial stage of obturation completes the endodontics triad. Achieving a "fluid tight seal" and performing an obturation correctly and appropriately are critical to the outcome of endodontic treatment. Among the several obturation procedures available, selecting a specific technique depends on the anatomy of the root canal and attaining case-specific goals. Warm vertical compaction and lateral condensation are the two fundamental obturation techniques. Modern tools and methods have emerged, like those that use vibration and heat to cause the obturating material to condense and compact. These innovations have fundamentally changed the field of endodontics and increased the predictability of obturation success.

Introduction:-

The ultimate clinical objective of root canal treatment is the three-dimensional obturation of the root canal space after being shaped and cleaned. The purpose of obturation is to seal the main root canal and all the 'portals of entry and exit' to impede any future communication or exchange between the endodontium and periodontium. Complete seal of the root canal system is important in order to prevent the microorganisms from invading the periradicular tissues[1]. According to a literature review by Arzu S Demir et al[2] it has been demonstrated that about 65% endodontic failures are related to incomplete obturation of the root canal, where there can be post-operative complications.

Two things is important while doing obturation –obturating material and obturating technique.

Many materials have been tried from ancient times till present as root canal filling material. The first material that was used was bronze wire in 200 B.C. [3] Then various materials were started to be used as obturating materials. The obturating materials used were –
- Lead and gold foil
- Paraffin paste
-Silver points
-Resin cone
-Gutta percha

But none of these materials proved to be ideal as obturating material. Still silver point, resin cone and gutta-percha are used for obturation.

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Metal as Obturating Material:-

Among the different metals only biocompatible metals are useful as obturating maerial .Different noble metals like gold, silver, platinum, palladium etc are available but among this pure silver only can be used because pure gold is very soft and platinum is very hard. Silver is used as silver points having the same diameter and taper as ISO size files and reamers, were introduced by Jasper in 1933. Silver points were widely used in the 1930s for obturation, particularly in smaller canals and torturous canal. They were fabricated to the same size as instruments used in the preparation of the root canal. Silver points had the advantages of being easy to insert, radio-opaque and length control was easier. Although silver points fulfilled many of Grossman's requirements, the main drawback of silver points is that they do not seal root canal laterally or apically because of their lack of plasticity. Silver points cannot adequately fill all the canal space and cannot be compacted into spaces or voids within the root canal system. One major drawback is its phenomenon of getting corroded with time due to the moist surrounding inside the root canal. Corrosion product may go to periapical region and cause failure of root canal[5].

Gutta percha as obturating material:-

The search for the ideal obturating material ended with the introduction of gutta percha by Bowman in 1867 that used it for filling the root canal in the extracted first molar. Gutta-percha is a rigid natural latex derived from the sap of rubber trees of genus Palaquium gutta and it has got zinc oxide fillers as its principal component. A standard biomaterial for obturation is that which fills the cavity and forms a fluid tight seal to prevent fluids from moving in and out of the root canal spaces[5]. The most common solid core material for obturation is the gutta-percha. It is a material with minimal toxicity, minimal tissue irritability and is least allergic when used within root canal system. Hence, Gutta-percha is the preferred choice as a solid, core filling material for canal obturation.

Resin as filling material

To overcome the limitations of gutta-percha and other sealers a resin-based root canal filling material, Resilon/Epiphany was introduced. Resin based obturation systems like Resilon is a relatively new material which exhibits the properties of gutta-percha and looks like it. It is comprised of the polymer polycaprolactone. It is used with an adhesive sealant, "epiphany" in the attempt to create "monoblock", however, the existence and survival of such a physical entity is not proven. It exhibits thermoplastic and chemical properties similar to gutta-percha and is inert[6].

The aim of the review is to explore different obturation techniques in the procedure of root canal treatment.

Obturation techniques:

Different methods for obturating a shaped and cleaned root canal system includes- Resin based obturation method, Chemical softening of gutta percha,Cold lateral compaction technique,Warm vertical compaction method, Carrier based gutta percha technique,Thermo-mechanical obturation technique,System B technique, Thermoplasticized gutta percha technique ,Warm lateral condensation technique,Single cone technique.

A. Chemical Softening Of Gutta-Percha

This technique was described by Callahan and Johnston at 1900s. It used chloroform to chemically soften gutta-percha. In this technique gutta-percha particles are added to chloroform to produce a sealer (chloropercha), which has the same color as gutta-percha. Then the mixture can be used as a sealer with gutta-percha cones for obturation of the canal.

The technique has several drawbacks:- first when the Chloroform evaporates, the material undergoes a significant shrinkage, compromising the apical seal. If the root canal is filled with chloropercha alone, two thirds of the material will be lost on evaporation of the solvent. Second the operator must be very careful to avoid overfilling because of the reported toxicity of the solvent on tissue.

American Food and Drug Administration have studied and demonstrated that chloroform is potentially carcinogenic.Chloroform can be substituted with eucalyptol and organic solvent and can be used as Eucapercha. Its tissue toxicity is much lower than chloroform, and it is used medicinally as a decongestant and rubefacient. Eucalyptol was also reported to possess antibacterial action and anti-inflammatory properties. [7]

B. Cold Lateral Compaction Technique:-
Callahan in the year 1914 introduced this technique. In this technique a master gutta-percha cone is placed with sealer and the spaces around it are adapted with the accessory cones of different ISO sizes to get homogenous seal of the root canal. It has been the popular method for obtaining obturation in the coronal, middle and apical thirds of the canal space. The gutta-percha is selected according to the last file used for preparation and tug back at the apical region according to working length measured. The sealer is applied first in the canal and then master gutta-percha cone coated with sealer is applied. The additional gutta-percha cones are placed as required and compacted with the help of spreader.

Advantages
1. Controlled placement of GP in the canal.
2. The placement of various GP cones applied with the sealer fills up the space inside the canal homogenously.

The major limitation is that it is a time consuming procedure.
- The main problem is the occurrence of voids in between the cones if not compacted properly within the root canal.

C. Vertical Compaction Of Warm Gutta-Percha
The vertical compaction technique of warm gutta-percha had been described by Schilder in 1967 and the obturation has been carried out in simple and more complex canals. Gutta-percha softened by heat is vertically compacted into the conically shaped canal preparation.

Weine described that vertical compaction is to be preferred in certain cases, such as when the fitting of a conventional master cone to the apical portion of canal is not possible, or when there is unusual canal curvature or any formation of ledge, perforation or in internal resorption cases.

Armamentarium
The instruments used to compact the gutta-percha in this technique are similar to the amalgam compactors but somewhat longer and narrower. These instruments are referred to as compactors or ‘pluggers’.

The other instrument requires is the ‘heat carrier’ that is used to deliver heat to the gutta-percha cone in the root canal. Several types of heat carriers are available, like the Touch ‘n Heat (SybronEndo), the Calamus (Dentsply Tulsa Dental). These instruments are provided with different diameter and tapered tips.

Gutta percha cones
The gutta-percha cones indicated for this technique are more conical and tapered. These cones provide a larger amount of gutta-percha on which vertical force can be exerted with the working surface of the pluggers. In the Schilder technique the sizes most commonly used were “fine”, “fine-medium”, “medium”, and “medium large”.

Sealer
A minimum amount of sealer is necessary to ensure better adaptation of gutta-percha to the canal walls. The ideal sealer for this technique is one that can be spread onto the walls of the canal as a microfilm of few microns thickness.

Advantages
1. Excellent apical and lateral seal of the root canal
2. Provides good results for obturation of larger lateral and accessory canals

Disadvantages
1. More amount of time is needed
2. High risk of vertical root fracture resulting from undue force
3. Periodic overfilling with gutta percha or sealer that cannot be retrieved from the periradicular tissues

C. Carrier-Based Gutta-Percha Technique
The Thermafil obturation technique was developed by W.B. Johnson in 1978. The first Thermafil obturators that were used initially were stainless steel K-files covered with a uniform layer of gutta-percha. The obturators were then heated and placed in the canal, already coated with sealer, and sectioned at the level of the pulp floor.

SimpliFill is employed following canal preparation using Lightspeed instruments. In this system, there is 5mm of guttapercha as an apical plug to the carrier. After preparing the root canal, the carrier is advanced within 1mm of the canal length prepared, pushed to the determined length using digital pressure and the carrier is then severed rotating the handle counter clockwise atleast four times. The remaining coronal space can then be filled with gutta-percha.

Advantage.
There is effective sealing of lateral and accessory canals

Disadvantage.
There can be occasional extrusion of materials beyond root apex.

D. Thermoplastic Gutta-Percha Technique
The thermoplastic gutta-percha technique was introduced by Yee et (1977).It consists of injecting gutta-percha, heated by an electrical device, into a prepared root canal. The instrument has a gun-like shape whose cartridges are small gutta-percha cylinders that are heated to a temperature regulated by the user. Exerting pressure on the trigger activates a piston that presses the gutta-percha towards the tip of the instrument. The gutta-percha is then conveyed through a thin silver needle that, when appropriately bent, allows its operation in root canals of different teeth.

This technique uses sealer that also lubricates the plastic material on its path towards the apex.

Weller et al. observed that the thermoplasticized injectable technique exhibited the best adaptation to the prepared root canal walls, when compared to Thermafil and cold lateral condensation[8]

A drawback of this technique is that it lacks good and predictable apical control during obturation. To prevent apical extrusion of the plasticized gutta-percha into the periodontium, the operator must make a good “apical barrier” during the shaping procedure.

Another limitation is the high temperature that the gutta percha reaches within the syringe (160°C or more) before being introduced into the root canal.

Michanowicz et al. [9] introduced a device for thermoplastic gutta-percha at a temperature of 70°C. It is loaded with carpules of gutta percha with needles and placed in a device that externally heats the carpule and needle to the temperature. He suggested that this technique can be more successful in filling the dentinal tubules of the coronal and middle thirds of the canal.

The technique may be confidently used only when there is no risk of introducing material beyond the apex, in the following circumstances such as: un-negotiable canals where it is necessary to fill the canal space as much as possible, via coronal approach, prior to surgical root end filling. When the root end closes and matures after apexification. And also in the root canals where a perforation is present in the apical third of the root.

The first commercially available thermoplasticized gutta-percha system was the **Obtura system**. Another device became available recently is the B&L Beta 2 that is easier to handle as it is cordless. The temperature varies from 150°C to 230°C, and the needles are of different sizes: 20-, 23-, or 25-gauge.

Ultrafil
The Ultrafil is a low- temperature thermoplasticized gutta-percha delivery system that contains prepackaged cannulas with attached 22-gauge needles. The gutta-percha is prepared in the alpha phase form so that it softens in the heating unit at temperatures between 70 to 90 degrees celsius.

F. System B Technique
The System B technique or “single wave of condensation technique is an additional heat-assisted gutta-percha compaction technique” introduced by Buchanan in 1996. It can be considered a variation of the Schilder technique, where instead of using a heat carrier and cold cylindrical pluggers, only one tapered heated plugger is used during the down-packing.

Lea et al. compared the density of standard cold lateral gutta-percha compaction and warm vertical compaction using the continuous wave of condensation technique. They concluded that warm vertical compaction, using the System B, resulted in significantly greater density of gutta-percha fill compared to standard cold lateral gutta-percha compaction.[10]

Romero et al. in the year 2011 studied the heat transfer to the periodontal ligament during the obturation of root. They found that the "Continuous Wave Technique", when performed with a controllable heat source such as System B, causes only negligible temperature increases in the periodontal ligament.

H. Single Cone Technique:-

In this technique, obturation is carried out with the use of a single cone which is the master cone with the help of sealer that is coated against that cone; here accessory cones are not necessary. Since the master cone adapts to the size of the rotary instrument used in the root canal. Therefore void free non- permeable filling can be achieved that prevents the leakage between the coronal and apical aspects of the canal[11].

This technique is generally indicated only in teeth with straight canal. This is because if used in complex root canal anatomy, this technique has shown poor results in terms of quality, marginal infiltration and bacterial penetration when compared to other techniques.

The advantages to this technique are that it is a simple technique where less time is needed for obturation. Also there is good adaptation of the gutta percha cone with the root canal wall.

I. Resin Based Obturation Method - Resilon

Resilon obturating points (Pentron Clinical Technologies) and the resin sealer Epiphany or RealSeal (Sybron Endo) have come up to be used in combination with a self-etch primer after smear layer removal, to allow creation of a solid 'monoblock' (a material that is contiguous from its resin tags in patent dentinal tubules through sealer to the core canal filler).The material obturate canals with anatomic variations well (especially through the compaction of warm obturation techniques).

Resilon is a polycaprolactone core material with difunctional methacrylate resin, bioactive glass, and radio-opaque fillers. The polyester core material is available in ISO-sized points with accessory points for lateral compaction and warm vertical techniques, or pellets for use in thermoplasticized techniques. [12]

Coronal seal plays a critical role for success in endodontic treatment. Shipper et al.reported that Resilon showed minimal leakage. Stratton et al. and Von Fraunhofer et al. studied the sealing ability of Resilon and Epiphany sealer versus gutta-percha and AH Plus sealer and found significantly less leakage when Resilon was used. RealSeal points are available in kits of various configurations and as individual components with variable taper and tip sizes and along with accessory points ranging from x-fine to large).

The disadvantage is that excessive removal of dentin can occur during the removal of smear layer that can weaken the root making it more susceptible to root fracture. The interfacial strengths of Resilon with Epiphany sealer have been compared with those of gutta-percha with AH Plus sealer by Gesi et al in 2005.They found that the gutta-percha/ AH Plus testing group exhibited significantly higher interfacial strength than did the Resilon/Epiphany group, when premature failures that occurred in Resilon root slices were included. The gutta-percha root slices failed exclusively along the gutta-percha/sealer interface.

Discussion:-

According to the American Association of Endodontists obturation is defined as 'the method used to fill and seal a cleaned and shaped root canal using a root canal sealer and core filling material'. The time of obturation is dependent upon various factors that influences it such as the pulpal and periapical diagnosis, the radiographic presentation, the patient's signs and symptoms, the degree of difficulty, patient management issues etc. The ideal length to which the canals should be obturated varies amongst the clinicians. Preferences vary between treating till the radiographic apex or foramen, reading on an apex locator, or 0.5-1 mm short of the radiographic apex. Research has supported the outcome of root canal treatment to be good when the canal is filled 0-2 mm from the radiographic apex. Gulabivala K et al concluded in a prospective study of factors that affected the outcome of the root canal treatment that the extension of cleaning a canal as close as possible to the apical terminus significantly improved the

periapical healing. Cathro and Love studied and concluded that System B and Obtura II produced more homogenous obturation with gutta percha using minimm sealer and almost no voids. The reason for lesser voids is that it involves placing of small aliquots of thermosoftened gutta percha within the root canal and individually condensing them. The highest percentage of gutta percha is found in system B which is very close to that observed with Obtura can be supported by the fact that both have similar thermoplasticized and beta phase technique. Growing attention is given in recent years to the use of single cone obturation technique. In this technique, the canal is obturated with a single gutta percha cone that is closely matching with the size and taper of the canal preparation. Single cone technique is advocated to be used with bioceramic sealer.

Conclusions:-

There are different techniques available for obturating the root canal, the selection of which depends on many factors like skills, experience and the situation of the root canal morphology .The lateral condensation is the most favoured technique that is widely accepted by the dentists. The modified contemporary obturation techniques are more efficient than the conventional ones because of the enhanced quality of filling and minimal percentage of leakage, more homogenous filling as a result better obturation in the long run. Nevertheless, the more comprehensive development of current obturation techniques are needed to justify the best quality of endodontic obturation.

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