ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 15, Issue, 01, pp. 67351-67356, January, 2025
https://doi.org/10.37118/ijdr.28801.01.2025

RESEARCH ARTICLE **OPEN ACCESS**

GUTTA PERCHA –AN UPDATE

***Dr. Anusha, K. and Dr. Krishnaprasada L**

ESIC PGIMSR Medical College and Hospital, Bangalore

ARTICLE INFO

Article History:
Received 20th November, 2024
Received in revised form
14th December, 2024
Accepted 21st December, 2024
Published online 24th January, 2025

Key Words:
Gutta percha, Zinc oxide, Alphaform, Betaform, Obturation.

****Corresponding author: Dr. Anusha, K.***

ABSTRACT

Gutta-percha has been the predominant root canal filling material for over a century. Though it was introduced as restorative material initially, later it became soul of endodontics, helped in development of endodontics as a speciality. It is well known for its properties. There are many articles dealing with various techniques of usage of Gutta-percha, but the present article deals briefly with the discovery, sources, chemistry, commercial manufacture, its evolution, phases of gutta-percha, properties, forms of gutta-percha, uses, advantages and disadvantage. This article is an attempt to present comprehensively about a material, which we use commonly, yet we know very little about it.

Citation*: *Dr. Anusha, K. and Dr. Krishnaprasada L. 2025. *"Gutta Percha –An Update". International Journal of Development Research*, 15, (01), 67351-67356.

INTRODUCTION

The prime objective of operative endodontics is to thoroughly debride the pulpal space, creating a fluid–tight seal at the apical foramen and total obturation of the root canal. It has been reported that previously root canals were filled with amalgam, asbestos, balsam, bamboo, cement, copper, gold foil, iron, lead, oxy-chloride of zinc, paraffin, pastes, plaster of paris, resin, rubber, silverpoints, tin foil etc,but among all these materials tried, none of them met the requirements of an ideal obturating material[1]. The search for anideal Root canal filling material continued and ended with the discovery of "Gutta-percha".Guttapercha is considered as gold standard filling material more universally approved and used for its properties which are close to the characteristics of the ideal filling material.[2]

Discovery: Gutta-percha is a name derived from two words. "GETAH"- meaning gum "PERTJA"- name of the tree in Malay language. John Tradescant was the first person to discover and bring this material after his travel from far-east and named it as "Mazer wood" in 1656.Dr. William Montogmerie, introduced GP to the Western World in 1843,he was a medical officer in Indian service,he first came across gutta-percha in Singapore in 1822, he saw that gutta-percha were used by workers to make the handles for their machets, this sparked off his interest in latex, he sent samples from Singapore to the Royal Society of Arts in London. There it was demonstrated that the material could be moulded after heating in hot water and that it retained its tough state on cooling,he was the first one to be appreciated for the potential use of gutta-percha in medicineand was awarded the gold medal by the Royal society of arts, London in 1843. The first patent for GP was obtained in 1864 by Alexander, Cabriot, and Duclos, for a laminate consisting of three layers called "Gutta-percha fabric" which opened a Broadway for its industrial use. [2,3] Michael Faraday discovered that GP was an excellent electrical insulator,from then insulated wires and cables became a technical and commercial possibility. In 1850 the first submarine telegraph cables were laid and by the end of the nineteenth century over 250,000 miles of GP insulated telegraph cable were in use. This application was to continue for 100 years until replaced by polyethylene. Gutta percha was also used as Insulator for underwater telegraph cables. The gutta percha golf ball period lasted from around 1848 well into the 1900s. In 1848 GP balls were introduced for golf. Until then feathers encased in leather were used which was very expensive and quickly became unplayable in wet weather. Balls made of solid GP had no such disadvantages and their cheapness and reliable performance was a major influence in the vast expansion of the game in subsequent years.In medicine GPwere used as splints for holding fractured joints and manufacture of handles of forceps, catheters. used to control hemorrhage in extracted socket wounds, They were also used for skin diseases by the dermatologists, particularly against Small pox, Erysipelas, Psoriasis and Eczema.[1,2,3]

Evolution into Dentistry: Edwin Truman first introduced Gutta-percha into dentistry as a temporary filling material.

1847 - Hill Developed "Hill's-stopping" a restorative material, a mixture of bleached Guttapercha and carbonate of lime and quartz.
1867 - Bowman was the first to use Guttapercha for root canal filling at St Louis Dental Society. 1883 - Perry used pointed gold wire wrapped with soft Gutta-percha, rolled and packed it into the canal.

1887 - S.S White Company was the first to start the commercial manufacture of Gutta-percha points.
1893 - Rollins used Gutta-percha with pure oxide of mercury into root canal filling.
1911 - Webster-Heated GP-Sectional method of obturation.
1914 - Callahan introduced softening and dissolution of Gutta-percha with the use of rosins in obturation.
1959 – Ingle and Levine were the first persons to propose standardization of root canal instruments and filling materials,later standardized Gutta-percha was introduced to the profession in 1959 after 2nd International Conference of Endodontics at Philadelphia.
1967 - Schilder-Warm vertical compaction technique of gutta-percha was introduced
1976 - A group evolved into the present day International standardsorganization (ISO) for approval of specification of root canal instruments and filling materials.
1977 - Yee et al.-introduced Injectable ThermoplasticizedGP ,
1978 - Ben Johnson introduced Carrier based GP-Thermafil technique.
1979 - McSpadden-Special compactor was developed,it was used to Soften the GP by frictional heat.
1984 – Michanowicz introduced Low temperature Injectable GP-Ultrafils,
2006 - ADA specification for obturating Guttapercha points is No.78.

From then onwards, there was a great surge in the development of root canal therapy as a speciality. Although various cleaning and shaping methods have since been introduced, Guttapercha remains to be the main core material used for root canal fillings materials .[1,4,3,23]

Sources: Gutta-percha is a dried coagulated extract of Palaquium plants belonging to Blanco genus of Sapotaceae family.[5]They are natural inhabitants of South East Asia and other tropical countries.Isonandra gutta, Palaquium gutta and Dichopsis gutta are the main trees from where, Gutta-percha material is obtained.In India the species of this genus arescanty.

The species found are:

1. P. obovatum-Assam
2. P. polyanthum-Assam
3. P. ellipticum-Western ghats
4. P. gutta- trees in Assam and Western ghats,itwas recently introduced and planted in Botanical gardens, Bangalore,Lalbagh Botanical garden, Bengaluru, Karnataka.[6,4]

These Gutta-percha yielding trees are medium to tall trees, approximately 30 m in height, and up to 1 m in trunk diameter, in which a series of cuts are made to obtain the juice. The leaves of these trees also contribute to a minimal extent in Gutta-percha production.[1]

Manufacture: A series of "V" shaped or concentric cuts are made on the bark for the collection of milky juice in Areca palm conic receptacles.

Coagulation: The liquid that oozes out is collected boiled with little water. After boiling it is kneaded under running water to remove particles of wood and bark, later it is rolled into sheets to expel the air enabling it to dry quickly. It is placed in a revolving masticator and heated until it is fit for use. Chemical method of coagulation is by addition of alcohol and creosote mixture (20:1), ammonia, limewater or caustic soda[6].

Obach's technique : The obtained pulp is heated to 75°C in the presence of water to release the yellow gutta threads and then cooled to 45°C .At below 0°C temperature, this yellow gutta is mixed with cold industrial gasoline to dissolve the resins and denature any residual proteins later this mixture is dissolved in warm water at 75°C, and dirt particulates are allowed to get precipitate.The residual greenish-yellow solution is bleached with activated clay, filtered to remove any particulate, and then steam distilled to remove the gasoline.

The final commercially available formulation is "Final ultra-pure" (white) GP modified with appropriate fillers to overcome the odor of gasoline. It is finally combined with fillers, radiopaque material, and plasticizers to obtain GP cones for endodontic procedures.[7] It is relatively easy to make GP sticks as not much of precision is required. However, to make endodontic cones, the precision of standardization has to be maintained. It requires a special technology where all ingredients are blended and passed through the specification molds running under high vacuum suction or by injection molding and hand rolling.[4]

Composition: Gutta-percha is a Trans- isomer of poly isoprene. Its chemical structure is 1, 4, trans–poly isoprene.[8]The molecular structure of GP is close to that of natural rubber, which is a cis-isomer of polyisoprene. Both are highmolecular-weight polymers, structured from the same basic building unit, isoprenemer. Gutta percha and natural rubber has a number of similarities but it differs in its mechanical properties, as it behaves more like crystalline polymers.[4,9] In crude form, it is made of Gutta (75%–82%), Alban (14%–16%), Fluavil (4%–6%), and also tannin, salts and saccharine. The elasticity of GP and its plasticity at elevated temperature is determined by Gutta. Alban does not seem to have any harmful effect on the technical properties of GP. Fluavil is a lemon-yellow, amorphous body when it occurs in gutta in larger quantities it renders this material brittle.[4]

Different Phases of Gutta-Percha: In the year1942, C.W Bunnreported that Chemically pure Gutta-percha exists in two distinctly different crystalline forms termed as "alpha" and "beta" modifications, they differ by the distance between two consecutive -CH3 groups placed on the same side in relation to the carbons engaged in the double bonds (''molecular repeat distance''), they are interconvertible. Natural Gutta-percha coming directly from the tree is in alpha form,but commercial available products are in beta form[10]. During the process of manufacture, 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. When heated to temperatures of 42^0 to $49\ ^0$ C, 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 56^0 to $62\ ^0$ C, but the properties at this level are not well known and seem to be similar to that of the alpha phase.If this amorphous gamma material is cooled rapidly, β form recrystallizes whereas if it is cooled extremely slowly less than 0.5°c/hr, α form recrystallizes. Factor determining the melting point of "alpha" and "beta" GP is the rate of cooling which, in turn, controls the extent and character of crystallinity in the material formed.Thistransistions between low and high melting polymorphs of Gutta-percha are reversible, cyclic phenomena[11,4,1].

Significance: 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 42^0 to 49^0 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.[1,12]

Aging of Gutta-Percha : Aging of gpcones results in brittleness. The Encylopedia Brittanica[24] states that oxidation of Gutta-percha cones causes brittleness. Aged brittle cones can be made reusable by a rejuvenation process of heating – quenching treatment. The cones are immersed in hot tap water (>55° C) for one or two seconds and then immediately immersed in cold tap water (< 20° C) for several seconds. [1]

Properties of Gutta-Percha

Physical and thermo-mechanical properties: Gutta percha is temperature sensitive and viscoelastic material.At room temperature, it exists in a stiff and solid state. It becomes brittle on prolonged exposure to light and air due to oxidation. It becomes soft at 60°C and it melts around 95°C–100°C with partial degradation. Lower temperatures increase the strength and resilience, while an increased temperature will decrease resilience, especially when the temperature of gutta-percha exceeds 30 C.[4,12] At low temperatures, it tends to be brittle and may fail (fracture) before yield strength is attained. At high temperatures, a definite yield point may even disappear. The physical properties of tensile strength, stiffness, brittleness, and radiopacity depend on the organic (GP polymer and wax/resins) and inorganic components (zinc oxide and metal sulfates). Studies has shown that Zinc oxide increases brittleness, it is inversely proportional to percentageof elongation and ultimate tensile strength.[35]An account of the tensile strength of GP gives a reliable measure of its properties than compressive tests. Materials with the predominant property of ductility do not exhibit repeatable values for compression on account of resulting complicated stress patterns.[4] The property of viscoelasticity is critical during condensation of GP in obturation procedures which permits plastic deformation of the material under continuous load causing the material to flow.[25] The transformation temperatures of dental GP are 48.6°C–55.7°C for the β-to the α-phase transition, and 59.9°C–62.3°C for the α-to the amorphous phase transition, depending on the specific compound, heating dental GP to 130°C causes physical changes or degradation.[26]

Table 1. Composition 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

Table 2. Characteristics

PHASES	PROPERTIES
Alpha (α) form	Brittle at room temperature Gluey, adhesive and highly flowable when heated (lower viscosity) Example: Thermoplasticised gutta-percha used for warm condensation obturation technique
Beta (β) form	Stable and flexible at room temperature Less adhesive and flowable when heated (high viscosity) Example: Commercially available gutta-percha used for cold condensation obturation techniques
Gamma (γ) form	Similar to α- form, unstable

Table 3. Physical properties of Gutta percha

PHYSICAL PROPERTIES	AVERAGE VALUES
Yield strength	1000-1300 psi
Resilience	40-80 in/lb
Tensile strength	1700-3000 psi
Elastic modulus	15,500-28,000 psi
Flexibility	0.07-0.12 in/lb
Elongation (%)	170-500

Forms of Gutta-Percha

1. Solid core GP points (beta phase).
   - Standardized points: Correspond to instrument taper and apical gauge
   - Nonstandardized points: Variable taper, the tip of point to be adjusted after apical gauging to obtain an optimum fit and apical seal.
2. Thermomechanical compactable GP
3. **Thermo Plasticized GP:** Available in injectable form (alpha phase). Special heaters are provided in the systems to attain flowable temperature of GP. The apical seal is accomplished with the plugging of master cone and then the injectable GP is backfilled.
   - Solid core system
   - Injectable form.
4. Cold flowable GP.[27]

Different types Gutta-Percha Availability

Gutta-percha points: They have size and shape is similar to ISO standardization (2% taper from sizes No 15 to 140).

Greater taper Gutta-percha: They have taper other than 2%. They are available in 4%,6%,8% and 10% sizes.

Variable taper Gutta-percha: They have points suiting the taper of variable taper shaping instruments like protaper F1, F2 and F3.

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, e.g. Thermafill.

Gutta flow: In these powdered gutta percha is incorporated in resin based sealer.

Syringe system: Low viscosity gutta-percha is used, e.g. Successfil.

Gutta-percha pellets/bars: Availability in small pellets and are used for thermoplasticized gutta percha obturation, e.g. Obturasyatem.
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.

Modifications of Gutta Percha: Attempts have been made to obtain optimum seal and therapeutic effects by addition of various materials.

Surface modified gutta percha: One of the drawbacks of GP is that it lacks true adhesion. Hence, improvization for enhanced adaptability of GP has been attempted by surface modification with the following materials.

- ***Resin coated***: A resin is created by combining diisocyanate with hydroxyl-terminated polybutadiene, as the latter is bondable to hydrophobic polyisoprene (PI). This is followed by the grafting of a hydrophilic methacrylate functional group to the other isocyanato group of the diisocyanate, producing a GP resin coating that is bondable to a methacrylate-based resin sealer.[13]Ultradent Corporation has surface coated their gutta-percha cones with a resin (Ultradent, South Jordan, Utah). A bond is formed when the resin sealer contacts the resin-coated gutta-percha cone. The manufacturer claims this will inhibit leakage between the solid core and sealer. The technique calls for the use of EndoRez™ sealer (Ultradent, South Jordan, Utah) with this new coated solid core material.[23]
- ***Glass ionomer coated:*** Special technology fuses glass ionomer particles into the Gutta percha point. Another process applies an adhesive layer of particles to the surface of the Gutta percha. The result is a highly active surface prepared to chemically adhere to the Activ GP glass ionomer sealer. The sealer accompanied with this system is glass ionomer sealer;[37]results in a true single cone monoblock obturation. Glass ionomer creates an ionic bond with the dentin, is nonresorbable and not affected by the presence of residual sodium hypochlorite. Gutta-percha cones will be coated with glass ionomer (BrasselerUSA, Savannah, Ga.) and is designed for use with their glass ionomer sealer. Their system is called Active GP Plus™.[23]
- ***Bioceramic coated***: Bioceramic materials are incorporated and coated onto GP points which are available in specific sizes. They enhance the quality of obturation along with bioceramic sealers. These materials are in the form of nano particles calcium phosphate silicates nano particles to increase their

activity and to bring about better sealing by taking advantage of the natural moisture of dentin. These kinds of obturation bring about slight expansion rather than the shrinkage which is seen usually, which is very beneficial to seal the canals[14]EndoSequence BC Points are subjected to a patented process of impregnating and coating each cone with bioceramic nanoparticles. The bioceramic particles found in BC Sealer bond with the bioceramic particles in BC Points to form a true gap-free seal. Angie et alconcluded that bioceramic-based sealer (i.e., iRoot SP) is a promising sealer in terms of increasing in vitro resistance to the fracture of endodontically treated roots particularly when accompanied with Activ GP cones.[37]

- *Nonthermal plasma*: Argon and oxygen plasma sprayed to GP improves the wettability of GP by the sealer, favoring adhesion. Argon plasma led to chemical modification and surface etching while oxygen plasma increased surface roughness.[15]Maíra Prado et al in his study evaluated the effects of Oxygen and Argon plasma on gutta-percha surfaces and concluded that Oxygen plasma led to both topographic and chemical changes in the gutta-percha surface, while Argon plasma caused only chemical changes. Both treatments increased the surface free energy, favoring the wettability of sealers and influenced positively in the adhesion and leakage.[36]

Medicated gutta-percha

- **Iodoform**: IGP contains 10% iodoform (CHI3), a crystalline substance, which is soluble in choloroform and ether but low solubility in water. They interact with cell walls of microorganisms causing pore formation or generate solid-liquid interfaces at the lipid membrane level, which lead to loss of cytosol material and enzyme denaturation. It is said to inhibit the growth of Staphylococcus aureus, Streptococcus sanguis, Actinomyces odontolyticus, and Fusobacterium nucleatum, but not Enterococcus faecalis, Escherichia coli and Pseudomonas aeruginosa.[16]
- **Calcium hydroxide**: Calcium hydroxide Gutta percha (CGG) points combine the efficiency of calcium hydroxide and bio-inertness of GP to be used as temporary intracanal medicaments. The action is directly correlated to the pH which is influenced by the concentration and rate of release of hydroxyl ions. When used as an intra-canal medicament in endodontic therapy, moisture in the canal activates the calcium hydroxide and the pH in the canal rises to the level of 12+ within minutes. The resultant antimicrobial effects may be evident within 1–4 weeks[17]
- **Chlorhexidine**: Chlorhexidine (CHX) is a broadspectrum anti-infective agent which is a synthetic cationic bis-guanide. It acts by the interaction of the positively charged CHX molecule and negatively charged phosphate groups on microbial cell walls causing a change in osmotic equilibrium. CHX is both bacteriostatic (0.2%) and bactericidal (2%) and can penetrate the microbial cell wall by altering its permeability. Chlorhexidine impregnated GP points (Activ points) are known to be effective against E. faecalis and Candida albicans[18]
- **Tetracycline**: Tetracycline Gutta percha (TGP) contains 20% GP, 57% zinc oxide, 10% tetracycline, 10% barium sulfate, and 3% beeswax. They remain inert pending contact with tissue fluids; gets activated and become available to inhibit any bacteria that remain in the root canal or those that enter the canal through leakage. The greatest antimicrobial effect was seen on S. aureus and less on E. faecalis and P. aeruginosa[19]

Cetylpyridinium chloride (CPC): CPC, a quaternary ammonium compound and a cationic surfactant, has been used in antiseptic products and drugs. Although the antimicrobial mechanisms of CPC are not well understood, it appears to damage microbial membranes, thereby eventually killing microbes. Addition of CPC improved the antimicrobial property of GP in proportion to the amount added. However, this GP is not commercially available yet.[20]

Nanoparticles enriched gutta-percha: The era of nanotechnology has turned into the best innovation in the fields of health sciences and innovation. Nano is derived from the Greek word "υαυος" which means dwarf, and it is the science of producing functional materials and structures in the range of 0.1 nm to 100 nm. Nano particulates show higher antibacterial action on account of their polycationic or polyanionic nature, which expands their applications in various fields.

- **Nanodiamond-gutta-percha composite biomaterials**: Nanodiamond-GP composite embedded with nanodiamond amoxicillin conjugates was developed which could reduce the likelihood of root canal reinfection and enhance the treatment outcomes. NDs are carbon nanoparticles that are roughly 4µ - 6nm in diameter. It is a biocompatible platform for drug delivery, and they have demonstrated antimicrobial activity. Due to the ND surface chemistry, a broad-spectrum antibiotic, such as amoxicillin, can be adsorbed to the surface facilitating the eradication of residual bacteria within the root canal system after completion of obturation. The homogeneous scattering of NDs all through the GP matrix increases the mechanical properties, which enhance the success rate of conventional endodontic therapies and reduce the need for additional treatments, including retreats and apical surgeries.[21]
- **Silver nanoparticles coated gutta-percha** Silver (Ag) ions or salts possess sustained ion release, long-term antibacterial activity, low toxicity, good biocompatibility with human cells and low bacterial resistance. Dianat and Ataie have introduced nanosilver gutta-percha in an attempt to upgrade the antibacterial effect of GP, where the standard GP is coated with nanosilver particles. It demonstrates a significant antibacterial effect against E. faecalis, Staphylococcus aurous, Candida albicans, and E. coli.[22]

Clinical Considerations

- ***Removal of gutta-percha:*** Gutta-percha can be removed by using: Hand instruments, Rotary instruments, Ultrasonics, Lasers, Solvents, Microdebriders. The selection of each technique depends on the patient factors, the complexity of the root canal anatomy and ultimately the clinician operative skills and experience. GP retrieval is made easier by the use of organic Gutta-percha solvent. Mechanical removal of Gutta-percha will clear only the bulk of the material but the remnant in the form of debris needs to be removed by organic solvents. These solvents will soften the gutta-percha and will facilitate its easy removal. It is also safe to use solvents, especially when it is used deep inside the canal. The commonly used solvents are Chloroform, Halothane, benzene, Tetrachloroethylene, Xylene, Eucalyptus oil and refined orange oil.[28]
- ***Disinfection of gutta-percha:*** Handling, aerosols, and physical sources during the storage process can contaminate GP. The conventional process in which moist or dry heat is used cannot sterilize GP because this may cause irreversible physical or chemical alteration to the structure. Rapid chairside chemical disinfection is needed as the amount of GP points needed cannot be predicted beforehand. Sodium hypochlorite, glutaraldehyde, alcohol, iodine compounds, and hydrogen peroxide have been tried as GP cones disinfectant. The time ranges from a few seconds to substantial periods for these substances to kill microorganisms. NaOCl at 5.25% concentration is an effective agent for a rapid high disinfection level of GP cones. 2% CHX kills all vegetative forms in a short period but did not eliminate Bacillus subtilis spores within the times tested.[29]2% peracetic acid solution is effective against some microorganisms in biofilms on GP cones at 1 min of exposure.[30]Herbal extracts such as lemon grass oil, basil oil, and obicure tea extract, are probable alternatives for chairside disinfection of GP cones and have shown good results[31] Ethanolic extracts of Neem, Aloe vera, and

Neem + Aloe Vera have been seen to be successful in decontaminating GP cones against E. coli and S. aureus .[32]

Advantages

- Compressibility
- Inertness
- Dimensional Stability
- Tissue Tolerance
- Radio-opacity
- Becomes plastic when warmed
- Dissolves in solvents - chloroform and xylene
- Can be elongated when fresh, brittle when old

Disadvantages

- Lack of rigidity
- Lack of length control
- Easily displaced by pressure
- Lacks adhesive quality

Uses of Gutta-Percha

Assessment of Pulp status: Thermal stimulation is a standard means of assessing the vitality of teeth and hot GP has conventionally been the most popular. As controlled temperature is difficult to attain, it is imperative that heated GP should not be in contact with the tooth surface for more than 3–5 s, else may result in damage of an otherwise healthy pulp.

Tracing sinus tract: GP points are used to trace through sinus tracts to locate the source of infection and the offending tooth. Studies have indicated that GP is beneficial as a diagnostic adjunct and can be precise within 3 mm from the lesion. A mediumsized cone (size 25–40) has been found satisfactory due to its stiffness and ease of placement[33]

Manual dynamic irrigation*:* GP points are used for manual agitation of irrigants in the root canal to improve the cleansing ability of debriding and disinfecting solutions to remove the smear layer.

Temporization: The base plate and temporary stopping GP are used for this purpose after intra coronal tooth preparation and for double seal during endodontic interappointment periods. However, zinc oxide eugenol cements provide a better seal than GP. Hence GP for this purpose should be used discretely[34]

Assessment ofintracoronal tooth preparation: Assessment of intracoronal tooth preparation was used to check undercuts in tooth preparation requiring indirect intracoronal restorations.

CONCLUSION

Gutta-percha's unique property of inertness, better sealing ability and the ability to do re-treatment in case of failure, make it an indispensable obturating material currently. Gutta-percha has over the years have been modified in several ways to accommodate the growing trends in endodontics and achieve its mission by simplifying the techniques, achieving optimal seal with a better adaptation to the dentinal walls and a less time consuming process. In this continual process, newer products like selflengthed marked Gutta-percha have been developed and are in line for clearance of patency. In future, for Gutta-percha to remain indispensable certain property modifications are required such as increased stability, better flow properties, better intra-canal adaptation with reduced shrinkage and an inherent antibacterial efficacy without dissolution.

REFERENCES

1. Prakash R, Gopikrishna V, Kandaswamy D. Gutta-percha–an untold story. *Endodontology.* 2005 Dec; 17(2): 32-6.
2. Goodman A, Schilder H, Aldrich W. The thermomechanical properties of gutta-percha: II. The history and molecular chemistry of gutta-percha. Oral surgery, oral medicine, oral pathology. 1974 Jun 1; 37(6):954-61.
3. Thulaja NR, Abd Rahman NA. Gutta percha.
4. Vishwanath V, Rao HM. Gutta-percha in endodontics-A comprehensive review of material science. *Journal of conservative dentistry:* JCD. 2019 May; 22(3):216.
5. Gutta-Percha From The Columbia Encyclopedia, Sixth Edition. 2001 http://www.bartelby.com/65/gu guttaper.html,
6. Borthakur BJ: Search for Indigenous Gutta-percha. J. Indian. Endod. Society, 2002; 14: 24-27,
7. Guido E. Costa, James D. Johnson and Robert, G. Hamilton: Cross – Reactivity studies of Gutta percha, Gutta–balata and Natural rubber latex. J Endod 2001; 27: 584 – 587,
8. Franklin S. Weine: Text book of Endodontic Therapy: Canal Filling with Semi solid materials. 1996, The Mosby Company, 5th Edition., p 426-429,
9. Harvey Wickes Felter, and John Uri Lloyd. Gutta perchaFrom King's American Dispensatory http:/ www.ibiblio.org/ herbmed/eclectic/kings isonandra.html,
10. E. C. Combe, B.D. Cohen and K. Cummings: Alpha and beta-forms of Gutta-percha in products for root canal filling. Int. Endod. J 2001; 34:447-451,
11. Hillar M. Rootarae and John M. Powers: Determination of phase transitions in Gutta-percha by different Thermal Analysis. *J Dent Res* 1997; 56(12): 1453 – 1462,
12. Ferrante M, Trentini P, Croce F, Petrini M, Spoto G. Thermal analysis of commercial gutta-percha. *Journal of thermal analysis and calorimetry.* 2011 Feb 1; 103(2):563-7.
13. Tay FR, Loushine RJ, Monticelli F, Weller RN, Breschi L, Ferrari M, et al. Effectiveness of resin-coated gutta-percha cones and a dual-cured, hydrophilic methacrylate resin-based sealer in obturating root canals. *J Endod* 2005; 31:659-64.
14. Manappallil JJ. Basic dental materials. *JP Medical* Ltd; 2015 Nov 30.
15. Prado M, Menezes MS, Gomes BP, Barbosa CA, Athias L, Simão RA. Surface modification of gutta-percha cones by non-thermal plasma. *Mater Sci Eng C Mater Biol Appl* 2016;68:343-9
16. Shur AL, Sedgley CM, Fenno JC. The antimicrobial efficacy of 'MGP' gutta-percha in vitro. *Int Endod J* 2003;36:616-21.
17. Hegde MN, Niaz F. Case reports on the clinical use of calcium hydroxide points as an intracanal medicament. *Endodontology* 2006; 18:23-7.
18. Naik B, Shetty S, Yeli M. Antimicrobial activity of gutta-percha points containing root canal medications against E. faecalis and Candida albicans in simulated root canals–an in vitro study. *Endodontology.* 2013;25:8-18
19. Bodrumlu E, Alaçam T, Semiz M. The antimicrobial and antifungal efficacy of tetracycline-integrated gutta-percha. *Indian J Dent Res* 2008; 19:112-5.
20. Tomino M, Nagano K, Hayashi T, Kuroki K, Kawai T. Antimicrobial efficacy of gutta-percha supplemented with cetylpyridinium chloride. *J Oral Sci* 2016; 58:277-82.
21. Lee DK, Kim SV, Limansubroto AN, Yen A, Soundia A, Wang CY, et al. Nanodiamond-gutta percha composite biomaterials for root canal therapy. *ACS Nano* 2015; 9:11490-501.
22. Shantiaee Y, Maziar F, Dianat O, Mahjour F. Comparing microleakage in root canals obturated with nanosilver coated gutta-percha to standard gutta-percha by two different methods. *Iran Endod J* 2011;6:140-5
23. Deshpande PM, Naik RR. Comprehensive review on recent root canal filling materials and techniques–An update. *Int J Appl Dent Sci.* 2015; 1:30-4.
24. Gutta-Percha From the Encyclopedia Brittanica, Chicago, *Encyclopedia Brittanica inc.,* 1968:1053,

25. Friedman CE, Sandrik JL, Heuer MA, Rapp GW. Composition and physical properties of gutta-percha endodontic filling materials. *J Endod* 1977; 3:304-8.
26. Maniglia-Ferreira C, Gurgel-Filho ED, Silva JB Jr., Paula RC, Feitosa JP, Gomes BP, et al. Brazilian gutta-percha points. Part II: Thermal properties. *Braz Oral Res* 2007; 21:29-34.
27. Belsare LD, Gade VJ, Patil S, Bhede RR, Gade J. Gutta percha – A gold standard for obturation in dentistry. *J Int J Ther Appl* 2015; 20:5.
28. Aishuwariya T, Ramesh S. An Update On Gutta-Percha Retrieval Methods. *Int J Dentistry Oral Sci.* 2021 Feb 18; 8(2):1488-91.
29. Wourms DJ, Campbell AD, Hicks ML, Pelleu GB Jr. Alternative solvents to chloroform for gutta-percha removal. *J Endod* 1990; 16: 224-6.
30. Salvia AC, Teodoro GR, Balducci I, Koga-Ito CY, Oliveira SH. Effectiveness of 2% peracetic acid for the disinfection of gutta-percha cones. *Braz Oral Res* 2011; 25:23-7.
31. Makade CS, Shenoi PR, Morey E, Paralikar AV. Evaluation of antimicrobial activity and efficacy of herbal oils and extracts in disinfection of gutta percha cones before obturation. *Restor Dent Endod*., 2017; 42:264-72.
32. Decontamination efficacy of neem, Aloe vera and neem+ Aloe vera in guttapercha (gp) cones using Escherichia coli and Staphylococcus aureus as contaminants. *Asian J Microbiol Biotech Environ Sci* 2015; 17:917-20
33. Baldassari-Cruz LA, Walton RE. OR 3 effectiveness of gutta percha tracing sinus tracts as a diagnostic aid in endodontics. *J Endod*., 1999; 25:283.
34. Sivakumar JS, Suresh Kumar BN, Shyamala PV. Role of provisional restorations in endodontic therapy. *J Pharm Bioallied Sci* 2013; 5:S120-4.
35. Pesun IJ, Gardner FM. Fabrication of a guide for radiographic
36. Maniglia-Ferreira C, Silva JB Jr., Paula RC, Feitosa JP, Cortez DG, Zaia AA, et al. Brazilian gutta-percha points. Part I: Chemical composition and X-ray diffraction analysis. *Braz Oral Res* 2005;19:193-7
37. Prado M, de Oliveira Menezes MS, de Almeida Gomes BP, de Melo Barbosa CA, Athias L, Simão RA. Surface modification of gutta-percha cones by non-thermal plasma. *Materials science and engineering: C.* 2016 Nov 1; 68:343-9.
38. Doumani M, Habib A, Khallof RO, Albakheet MI, Alghamdi MG, Alowyyed TI. Activ GP system in endodontics: A review. *International Journal of Oral Care and Research.* 2019 Jul 1; 7(3):74.

****