

“Graphene” The New Addition in Dental Materials- A Narrative Review

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Introduction:

The dentists are always welcoming newer technology and new materials into their clinical practice. Though the existing materials are having good properties, still having few disadvantages. Hence the new material with good properties always will get scope to use in day-to-day dental practice. One such new entry into dentistry is Graphene material.

Novoselov KS and Geim AK discovered the Graphene material isolated using mechanical exfoliation by using sticky tape and in 2010, they received Noble prize. Graphene is a carbon sheet with hexagonal in nature having honeycomb structure with two dimensional (2D) crystalline material. [1]

The key feature of Graphene includes the high mechanical strength of 1100GPa, very light weight of 0.77milligrams per square meter (a paper is 1000 times heavier than the graphene) with highly flexible property. The breaking strength of 42N m1, huge surface area to mass ratio is 2630m2/g, 130 giga pascals of tensile strength. These peculiar properties of graphene material made this material which may occupy better place in the clinical dental practice. Graphene available in four categories to use in dentistry for different treatments. They are 1. single -layer graphene, 2. few-layered graphene, 3. graphene oxide (GO) and 4. reduced graphene oxide (Rgo).[2]

The graphene material is using in dentistry for various treatments, which include coatings on dental implants for the better osseointegration, act as guide for scaffold material for bone regeneration and drug delivery systems (DDSs) to induce bone membrane regenerative properties.[3]The graphene material having superior antibacterial properties and also improves the mechanical and tribological properties. According to Sun L et al., the fluorinated graphene mixed with glass ionomer cement, shown very good antibacterial effect. [4] The antibacterial activity depends on the size and thickness of the graphene nanoplatelets (GNP). Lower thickness and smaller size GNPs exhibit stronger

antibacterial especially against *S. mutans* and caries. whereas the nano particles of silver or zinc mixed with composites of graphene and GO shown superior antimicrobial effects. [5,6]. The graphene having role in the treatment of periodontitis [7], craniomaxillary bone deformities and dental pulp regeneration [8].

In the cancer therapy, the modified forms of graphene plays a crucial role in the form of biosensors for drug delivery as well in the tissue engineering. [9-11]The Graphene Oxide (GO) having major role in prevention of caries [6]. Graphene and its nanocomposites are proved as very good biocompatible material which can be used in the proliferation of newer cells. Addition of graphene to different resins, increases the bond and adhesive strengths. Graphene mixed resins are very useful in restorative dentistry, to prepare veneers, bridges, crowns and other direct restorations. [12] Bregnocchi A et al., [13] found that by adding graphene to different resins, the bond and adhesive strengths of resins increased. By placing tattoo of wireless graphene sensors on the tooth enamel, can detect the bacteria. [14]

It is possible to change the hydrophobicity of polymers to hydrophilicity by adding graphene material. Young HY et al., [15] stated that, the graphene material having quality to improve the mechanical, electrical, thermal properties by adding to most polymer based scaffolds. The bioactivity of Carbon fiber polyether ether ketone (C/PEEK) composite increased by adding graphene oxide as per Qin W et al. [16]The addition of graphene material to implant surface coating material can improve the cell proliferation, osteogenic cell behavior, antifungal and antibacterial properties [17]

Conclusion: Many studies revealed the superior properties such as antibacterial, antifungal and antibiofilm properties of graphened based materials. Various Nano forms of Graphene -based materials have been using for different treatments in dentistry. Graphene showing a promising future in the clinical dental practice, whereas still the evidence based clinical applications of graphene and clinical usage by the dental clinicians yet to take momentum.

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