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Study Of Dental Caries And Cavity And Help To Cure Them With Silver Nanoparticles And Its Composites

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Abstract:
Silver nanoparticles recently drawn attention in dentistry and medicine. Researchers are also focused on this area . If nanoparticles are fabricated it will be the core area of nanotechnology. They are often used in the dental industry because they prevent bacteria from making nanoparticles oxides and biofilms. The metabolism of bacteria get stopped once you apply nanoparticle. Silver nanoparticles (AgNPs) are a type of zero-dimensional material with different shapes. Dentistry are also change with patient needs and also by applying new technology. In the oral cavity silver nanoparticles can also be used for disinfecton. Silver nanoparticles (AgNPs) used in various biomedical application. Silver nanoparticles are widely used in the treatment of dental plaque and tartar. Also used in the treatment of bacterial and fungal infections in the mouth. The incorporation of AgNPs in dental industry has been used in increase the oral health and can be use in wide area. This review focuses on AgNP synthesis, chemical properties, biocompatibility, uses in various dental fields and biomaterials used in dentistry. This review paper also help to understand us the impact of silver nanoparticles on dentistry.

Keywords: *Silver nanoparticles (AgNPs), biocompatibility, antibacterial, dentistry, biofilm, nanocoating*

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I. Introduction:

Silver nanoparticles (AgNPs) have extreme level of biomedical application. Sterile gauze prosthesis and catheterization are examples of biomedical application. Low toxicity of silver ions and great biocompatibility with respect to human cells provide long-lasting bactericidal action [1]. Silver nanoparticles have strong antibacterial effect as it is used in numerous medicine. Wound stitches, tracheostomy, surgical equipment and bone prosthesis are examples of this. Use of AgNPs in dentistry as dental prostheses, restorative dentistry, implant ology and endodontic. AgNPs improving oral health by depositing bacteria on dental composites [2]. Due to small size of AgNPs it exhibit different physical, chemical and biological properties to bulk materials. They are effective antibacterial fillers because of their small size and vast surface area [Figure1] [3].

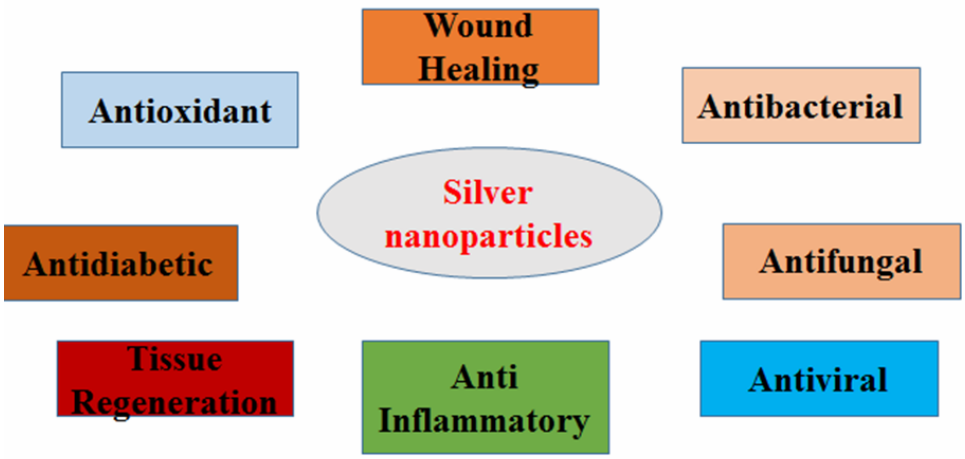

Figure 1: Silver nanoparticles have various biomedical application

'Nano' means extremely small particle ranging in size from 1 to 100 nm [4,5]. AgNPs have strong biomedical application for decades as antibacterial, antifungal and anti-inflammatory substance [4].

The antibacterial effect of AgNPs increases or decreases with respect to the concentration of Ag salt. Antibacterial effect also depends on the concentration of silver ions. AgNPs interact with different bacteria and invade cells due to their small size and external large regions [5]. Nanoparticles of various size and shapes can be created using a variety of processes, including physical, chemical and biological synthesis [6]. Streptococcus mutants are responsible for dental cavities due to their adherence properties.AgNPs within the size range of 1 to 10 nm have strong antibacterial and ant adherence properties against Streptococcus mutant bacteria [7]. There are several bacterial species depending on the bacterial cell wall structure. Both gram positive bacteria (GPB) and gram negative bacteria (GNB) exist. Depending on the length of the peptidoglycan layer bacteria can be divided in this two categories. GPB have 30 nm more thicker peptidoglycan layer than GNB. GNB have a 2-3 nm thicker peptidoglycan layer membrane made up of lipopolysaccharide [8].

Silver nanoparticles were used in various healthsector. Figure 2 [9] represent various action of AgNPs. In different literature different published data reveals that it can be incorporated in different sector. It was used in composite resin, adhesive systems, acrylic resin, root canal fillers, implantable devices. It exhibit microbial growth, neurotoxic effects and altered different materials present in a cell. This review focuses on several elements of dentistry, such as the dental implications of nanotechnology,

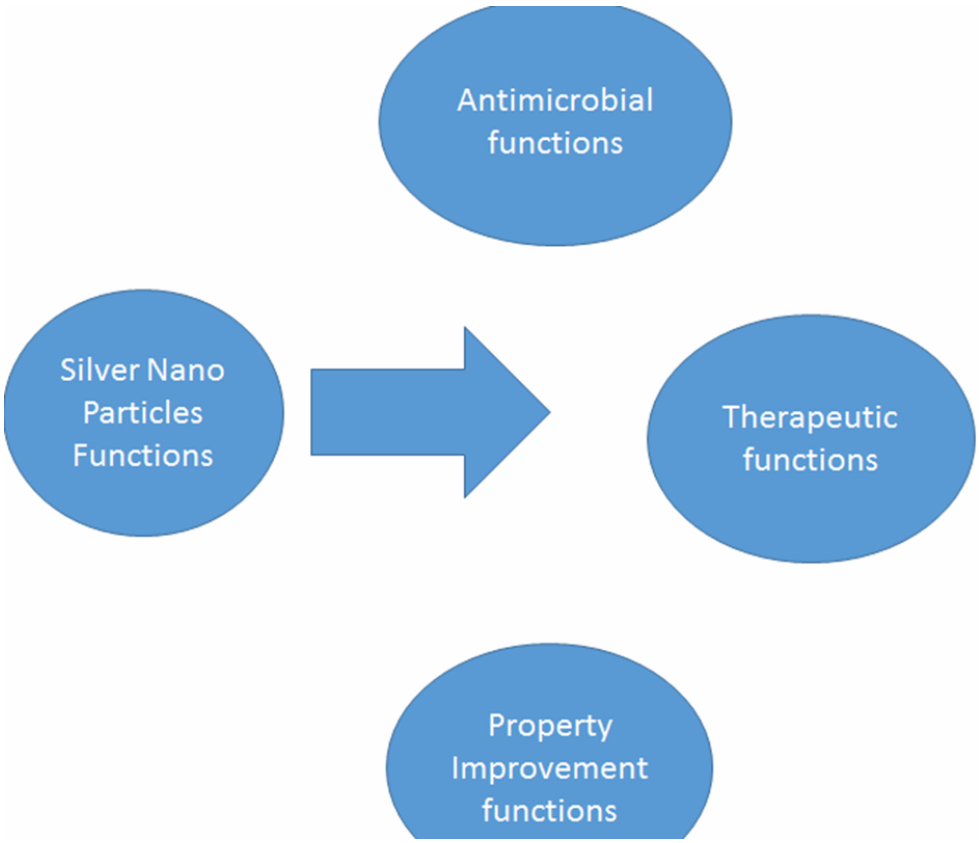

Figure2 : Various action of AgNPs represented in this Figure

clinical uses of nanoparticles in dentistry, and dental biomaterials, particularly the effect of silver nanoparticles (AgNPs).

II. Synthesis Of Silver Nanoparticle:

Metallic nanoparticles are produced by both chemical and green synthesis. A lots of metallic salts were used to prepare gold, silver, iron, zinc, copper, platinum and other analogous metal nanospheres. The formation of the nanoparticles depend on the parameters such as temperature, concentration of both reactant , pH, type of precursor, reducing and stabilising agents quality and molar ratio of different precursor. Different chemical reagents were used as reducing and stabilising agent of synthesis of nanoparticle.

Glucose, hydrazine, hydrazine hydrate, ascorbate, ethylene glycol, N-dimethylformamide (DMF), hydrogen, dextrose, citrate, sodium borohydride used to reduce metal salts [10]. Thiol stabilized gold and silver nanoparticle production were invented by Brust and his colleagues. Silver nanoparticle formation is a 3 step

process. At first silver particle reduced and moving freely as Ag (0) ions in the solution. Secondly agglomeration occur. In third step silver nanoparticle formed in bulk material [11]. In previous method sodium borohydride used as reducing and stabilising agent. Larger AgNPs formed as oligomeric clusters which have lesser application. Then citrate used as reducing and stabilizing agents which give lesser radius of nanoparticle and also control the shape [11]. Silver nanoparticle can also be synthesised by biological methods. Different plant extract and microbes were used as reducing and stabilizing agents. During the biological production of silver nanoparticles , the organism reduces Ag ions to Ag (0), functioning as a capping agent, reducing agent or stabilizing agent [11]. Due to low cost, most availability, high yields, low toxicity to the environment and human body, natural materials derived from plant and microbial sources would be of high demand in recent years [12]. In chart, (Figure3) summarizes different approaches of silver nanoparticle synthesis [13-16].

III. Clinically We Can Imply Nanoparticles In Dentistry:

Dental Implants :

Dental implants are most reliable process than tooth replacement. Biological and mechanical factors depend on successful implant of teeth. Biofilm formation occur on titanium implants causes failure of the implants. Peri-implant infection might disturb patients. Titanium surfaces also need metal coatings to prevent bacterial infection [17. Silver plasma immersion ion implantation approach in a single step causes deposition of AgNPs on the underneath of titanium teeth. This approach suppressed the growth of S. aureus and E. coli. It also improved osteoblast-like MG63 cell line development. AgNPs directly impact on surface cytotoxicity [18]. Bacteria present on biofilm causes dental carries, periodontal disease and abscesses. Carboxymethyl cellulose and sodium alginate capped AgNPs for antibacterial and anti-biofilm properties [19]. In comparison to sodium alginate AgNPs, carboxy-methyl cellulose-capped AgNPs suppressed mor Gram-negative bacteria (gram negative bacteria causes most periodontal infections) . AgNPs help to treat the coating so it can prevent bacterial rusting. Depending on antibacterial effect of different AgNPs. 5 nm is most effective than other oral anaerobic bacteria [20].

Anticancer Treatment:

Oral squamous-cell carcinomas are of major problem in the mouth and face. Radiotherapy and chemotherapy have both the potential to alter the homeostasis. The same is true for the disadvantages of anticancer drugs, which require research on other therapeutic options. In medicine and dentistry different type of nanoparticles efficiently treated malignant tumors. AgNPs are cytotoxic because they can damage DNA and cause apoptosis. However, studies on the efficacy of AgNPs in cancer treatment are scarce. In low doses AgNPs was also effective on tumor [21]. Berberine is a chemokine effective against cancer. So Berberine plus AgNP can also treat cancer cell line. Malignant cells was targeted specifically [21]. Clinician was getting data on application of AgNP as a valuable tool. Because it specifically kills cancer cells while preserving healthy ones, nanocarriers reduce the common side effects of chemotherapy.

IV. AgNPs Use In Different Dental Biomaterials:

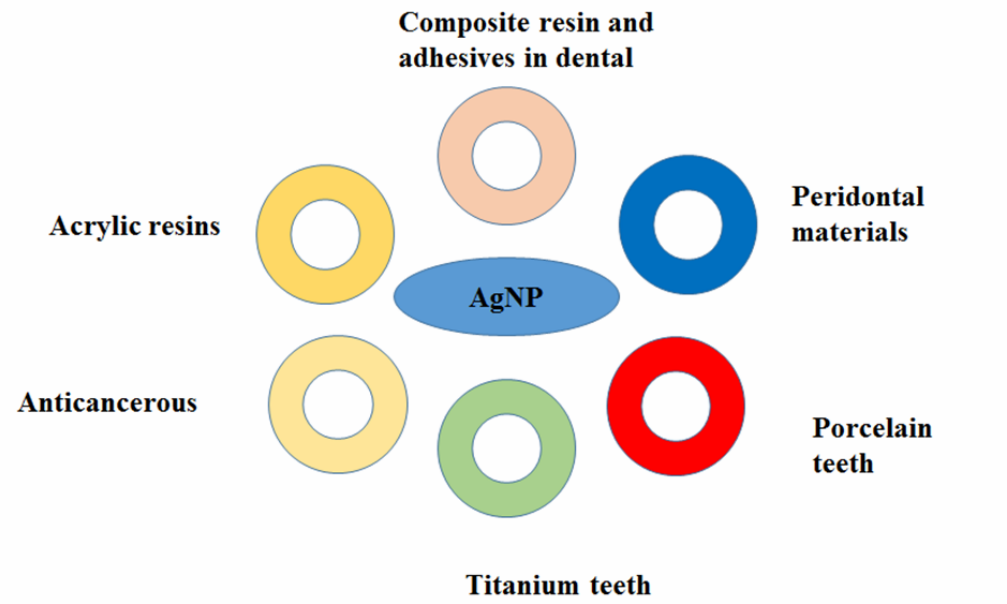

Figure 3: Incorporation of AgNPs in different type of teeth

Figure 3 represent the application of AgNP in different dental biomaterials. Application in a) Denture Acrylic Resin b) Composite Resins c) Endodontic materials d) Periodentology e) Orthodontic Adhesives and Cement f) Anticancer treatment

Denture Acrylic Resin:

Teeth prepared by PMMA (Acrylic polymers derived from poly (methyl meth acrylate) derivatives acrylic polymers. C. Albicns with timely variation can form a colony over resin teeth [22]. Denture cleansers and mouthwashes were used for the treatment of these microbes [23]. Resin without AgNPs if we add on two substance we could understand its resistance [24].

Composite Resins:

AgNPs were used in different mouthwashes, mouthcleaners and in resins to prevent biofilm infection. It promote good oral health. AgNPs can be easily invade cell membrane causes damage and inactivity. Research examining AgNPs in composite resins and adhesive systems is lacking [25]. This AgNPs prevent biofilm growth on the composite resin. AgNPs coupled with zirconium oxide (ZrO_2), calcium silicate ($CaSiO_2$) and portland cement (PC) (ZrO_2). Compression resistance was high for PC/ZrO_2 and AgNPs.Both treatment reduced the concentration of bacteria after 15h. Bacteria died and quality of cement increases. AgNPs composite with resins decreases the density of S.mutans. This mixture decreases the concentration of biofilm in oral cavity. AgNPs affected light-cured polymerized specimens production of important chemicals [26]. AgNPs affected composite resins. Composites attract biofilm more than any other material. These biofrilm causes secondary caries causes restoration failure. AgNPs combat with this problem. AgNP resin combat the problem of biofilm together. It destroy the QADM bonding agent [27]. Chemicals did not influence fibroblast cytotoxicity or microtensile bonding. AgNPs and QADM composite had effective step against biofilm formation [28].

Endodontic Materials:

Root canal material can destroy germ and increase tooth health. Root canal fillings material should be gutta-percha. AgNP and gutta-percha form a compositeand prevent microleakages from teeth. Several canal sanitizing agent such as chlorhexidine (CHX), sodium hypochlorite (NaOCl), ethylene diaminetetraacetic acid (EDTA) were use to clean root canal including AgNPs [29].

Periodontology:

Oral biofilms cause gum and tooth infection. Cavities, periodontal disease and abscesses are caused by biofilm bacteria. Peridontal disease, tooth loss are also cured by removing biofilm bacteria. Peridontal disease, tooth loss are also cured by removing biofilm. Carboxy methyl cellulose- capped AgNPs suppress Gram-negative bacteria more than sodium alginate AgNPs. Peridontal infection are most caused by Gram-negative bacteria. Size range of 5 nm particles caused oral infection prevention, Human pathogens can also be killed by AgNPs from banana peel extract [30].

Orthodontic Adhesives and Cement:

Orthodontic spots are more white and have cavities. Plaque builds around teeth for more acidogenic mouth flora. Plaque after removal mechanically antibacterial agents and Fluoride applied. AgNPs in adhesion with any other cement or adhesives give better clinical treatment than others [31].

Anticancer Treatment:

AgNPs can also treat cancer. Oral cancer can also be prevented by proper mouthwash and toothpaste. Near about 40% of cancer derived from the tongue [32].

V. Conclusion:

In the current research, it has been demonstrated that silver nanoparticles possess specific characteristics and can be utilized in a range of dental applications. Silver nanoparticles have great part in the field of dentistry it should be use in specific disciplines. AgNPs are also biocompatible with mammalian cells, further reassuring the medical community that using silver nanoparticles in dental materials is safe for humans. Greater research is necessary to prepare AgNPs less cytotoxic than any other present AgNPs. This is the case despite the fact that silver complexes have been shown to be effective.

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