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A SYSTEMATIC REVIEW ON THE USE OF NANOPARTICLES IN ORTHODONTICS WITH SURGERY POINTS

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Abstract

Currently, nanoparticles have the potential to revolutionize almost every aspect of dentistry, from radiographs and restorations to orthodontics and oral surgery. Their size and unique characteristics have given them a special ability to target and penetrate bacteria and tissues. The newest generation of dental composites is called nano composite. The particle size of nano composites is 20 nm. These very small particles, by connecting to each other, create larger particles that have higher strength and resistance than other composites, and in fact, this is their most important feature. Scientists are working hard to find ways to incorporate nanoparticles into almost every aspect of dentistry. Dr. Ranjeet Bapat, a professor at the School of Dentistry at the International Medical University in Kuala Lumpur and the leader of this research said: Recent advances in nanoparticles and nanotubes in dental surgery, endodontics and periodontal management have played an important role in improving the dental profession. Infection is one of the concerns seen in dental implant surgery. Implant rejection is one of the risks that occurs in 5 to 10 percent of cases. Therefore, the use of nano technologies that can reduce the risk of dental damage can create a revolution in this field of medicine. Dental nano methods are usually used to repair teeth; In other words, more time is needed for genetic design, design and tissue recovery, but with the growth of new teeth in laboratory conditions, the limitations of the dental field can be eliminated.

Keywords: Orthodontics, Nanoparticles, Composite, Implant, Dental Injuries.

INTRODUCTION

Nanotechnology can be effectively used to maintain oral and dental health [1-3]. In particular, silver nanoparticles are useful antimicrobial agents for bonding and covering the bases of prostheses and orthodontic appliances. They can also be used in dental restorative materials such as cavity liners, fissure sealants, and root canals [4]. There have even been tests of silver nanoparticles in washing the mouth and teeth. Its antimicrobial ability reduces plaque around

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the brackets, which can prevent tooth decay and caries during treatment. Also, nano technology can help reduce wear and tear by reducing friction between teeth and brackets. Researchers at the Carlos Universidad de Madrid and the Composites Group are developing a new process that uses nanoparticles to make invisible, friction-resistant brackets that make teeth wear-resistant while remaining transparent [5-7]. Adding nano-coating to wires and brackets can improve bracket performance. However, more research is needed on NiTi nanoparticles, which can provide orthodontic wires with new shape memory and superior performance. It is still difficult to isolate the required NiTi particles. The following are the most important differences between normal and nano composites:

- Nano composite has more strength compared to normal composite.
- The durability of normal composite is between 5 and 7 years, while nano ceramic composite can last more than 10 years and even up to 15 years if dental care is followed correctly.
- Nano composite polish ability is much higher than normal composite.
- The brightness of nano composites is higher than normal composites [8].

Advantages and Benefits

Research shows that the use of nano composites in composite restorations can have several advantages, including:

- Can act as an improved interface that increases stability and equal distribution of pressure between tooth and material (Figure 1)
- Its higher filler content makes it provide better mechanical properties.
- Its smooth surface prevents the accumulation of plaque and gum irritation and improves the beauty with proper color matching, high transparency and increasing the durability of the polish [9].
- A completely natural appearance due to the light that is scattered through the transparency of the nano composite, which makes it blend better with the adjacent teeth.
- These composites combine beauty and high strength (a great feature that is not seen in ordinary composites. They have relatively low strength).
- They can be polished easily.
- Due to their high mechanical resistance to wear and pressure, they can also be used in the restoration of posterior teeth.
- Having a wide color spectrum [10];
- The smoothness of these composites is enough to move well on the treated tooth and cover the desired surfaces. Therefore, the treatment process is easier with them.

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Orthodontics, like other fields of medicine, has made significant advances in technology.

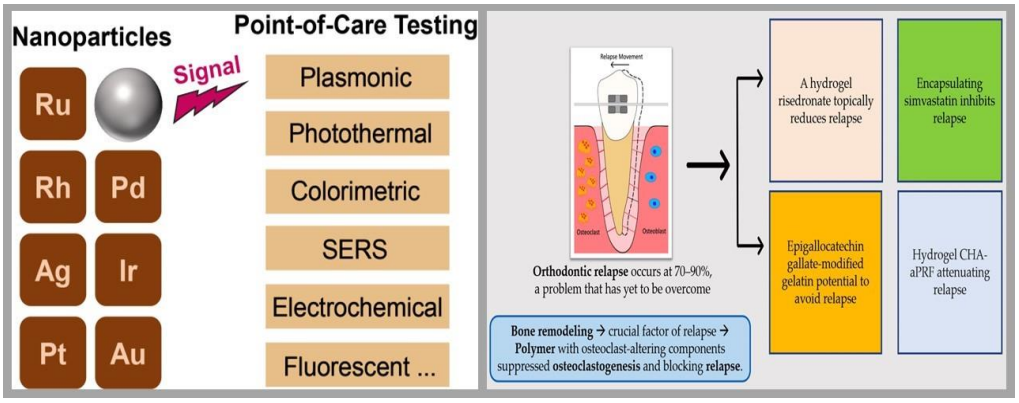

Figure 1: Stability and equal distribution of pressure between tooth and material

When it comes to orthodontics, the first thing that comes to mind is the old traditional metal brackets. But, in the world of orthodontics, there has been great progress, especially in the case of nanoparticles. You may ask yourself, what do nanoparticles have to do with brackets? Apparently, this relationship is very effective and vital. Nanoparticles are very small insoluble particles that can be manipulated at the atomic, molecular, and supramolecular levels in various healthcare applications [11-13]. Types of nanoparticles include nano pores, nanowires, nano belts, nano rings, and nano capsules.

6 Ways to Use Nanoparticles in Dentistry in the Future

Researchers at UCLA University have come to the conclusion that the use of diamond nanoparticles can lead to stronger and stronger treatments in dentistry. These particles are about 5 nanometers in diameter and are much more durable and stable than the diamond itself. For this reason, scientists believe that these particles can be used in the treatment of dental problems in patients with osteonecrosis who suffer from the constant breaking of their bones and teeth. The use of dental implants in these patients is not successful. Due to the weakness of the bone wall of the teeth, the implant is removed in these patients [14-16]. The restoration of this implant also requires a new and painful surgery. The use of diamond nanoparticles in solving the dental problems of these patients can create a revolution. During surgery for bone repairs and dental injuries, surgeons use sponges to create protein growth in the mouth. The discovery of these researchers indicates that the use of diamond nanoparticles does not require surgery. All that is needed is a simple injection or a simple oral rinse [17-19]. When this compound enters the mouth, the tiny nano particles release this protein with a continuous and slow flow. This protein is used in the new ossification of the walls of the teeth. This treatment method is very easy for patients and has a high degree of success in practice [20]. Currently, it has been tested on model cells and animals. It is hoped that its use will soon reach the implementation stage for humans. Diamond nano particles can have wider applications than dental uses; For example, these particles can be used in the treatment of cancers in which osteoporosis or bone weakness can be seen, as well as in orthopedic surgeries (Figure 2). Imagine that there is no need for plastering or splinting in fractures of the leg, hand and any other bone. A simple

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injection of nano diamond particles can fix a broken or cracked bone [21].

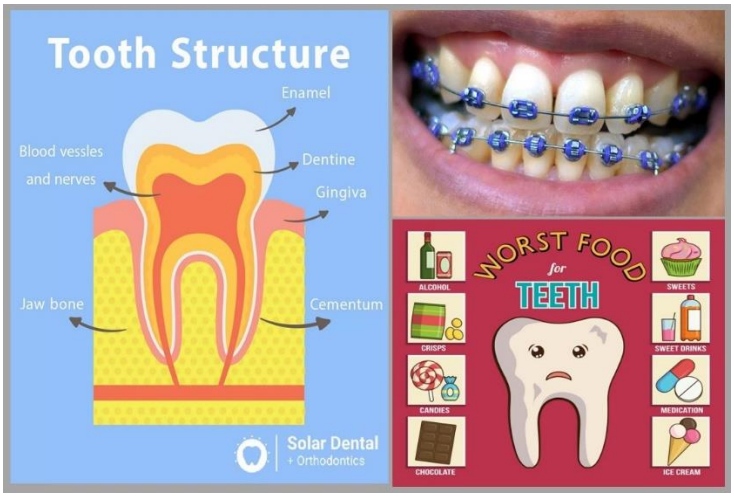

Figure 2: The Use of Polymers to Enhance Post-Orthodontic Tooth Stability

Stronger Restorations

One of the ways nanoparticles can help improve dentistry is their ability to create stronger and more flexible restorations. For example, a new study has shown that composites made of silica nanoparticles and silicon dioxide are stronger and more flexible than traditional composites. Other studies have shown that hydroxyapatite nanoparticles are biocompatible with the body and can be used to improve glass ionomer [22]. The authors believe that this work improves the mechanical properties of glass ionomer cement and the strength of its connection with dentin. Therefore, hydroxyapatite nanoparticles can be useful for addition to various restorative materials.

Dentures that Prevent Infection

According to the authors, several types of nanoparticles have antibacterial and antimicrobial properties that can be useful for inhibiting biofilm formation. In particular, silver nanoparticles (AgNPs) can be used for topical drug delivery. Another study has shown that silver nanoparticles can be used in the treatment of denture stomatitis. The researchers stated: Adding AgNPs to polymers that are used to improve tissue or tissue conditioners or as prosthetic bases has provided satisfactory results in the treatment of denture stomatitis [23]. Therefore, the addition of AgNPs to prostheses can prevent mucosal tissue-related infections.

More Effective Drug Delivery

Silver nanoparticles are not the only type of nanoparticles that have shown promising results for drug delivery and killing harmful bacteria. For example, gold nanoparticles have antimicrobial, antibacterial, and antifungal properties, and certain types of these nanoparticles may be used for medical and dental applications, including wound dressings, coatings, and adhesives. In addition, researchers found that nanoparticles chitosan can release chlorhexidine slowly during 48 hours and polymer nanoparticles can release chlorhexidine for four weeks

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[24]. Calcium fluoride nanoparticles (CaF_2) can deliver fluoride better than conventional systems. Another study showed that minerals absorb more fluoride from CaF_2 nanoparticles than from other sources. Researchers say: Calcium fluoride nanoparticles (CaF_2) have more reactivity and solubility than CaF_2 macro particles, and this is due to the increased solubility of CaF_2 nanoparticles compared to calcium macro fluoride particles, which increases the amount of fluoride absorption from CaF_2 nanoparticles. And is more effective in reducing tooth sensitivity [25].

Clearer Imaging

Nanoparticles not only have a direct impact on the oral environment; But they can also be used to improve dental imaging, because some types of nanoparticles create a coating on dental surfaces and cause teeth and gums to contrast with other oral structures in radiographs and images. For example, one study showed that gold nanoparticles can be used to help visualize dental structures in 2D and 3D imaging [26]. Other research has shown that iron oxide nanoparticles can be used to enhance contrast in magnetic resonance imaging.

Better Implants

Nanoparticles can also be used as a coating for implants and prevent the accumulation of bacteria and help implant Osseo integration. Silver, iron oxide, and copper nanoparticles all have antibacterial properties that make them suitable coatings for implants. In addition, gold nanoparticles increase the process of bone grafting to the implant. The researchers say: According to the stimulating effects of nanoparticles on the differentiation of osteoblasts, gold nanoparticles can also be used as osteogenic agents [27].

Restorative Toothpaste

Perhaps one of the most exciting properties of nanoparticles is their ability to help remineralize teeth. One of the in vitro studies has shown that hydroxyapatite nanoparticles together with silica and silicon dioxide nanoparticles reverse dentin demineralization up to 20% of the initial phosphate level of dentin. The same study also showed that a combination of nanoparticles reduces the breakdown of tooth minerals. Silica and silicon dioxide nanoparticles penetrate into demineralized dentin and cause heterogeneous mineralization of dentin collagen matrix exposed to an artificial saliva solution. Another application of this technology is the production of restorative toothpaste [28]. Two laboratory studies (in vitro) showed that toothpaste containing hydroxyapatite nanoparticles may strengthen the restorative and desensitizing properties of toothpaste (Figure 3). The researchers stated: Dentin and enamel remineralization using toothpaste containing hydroxyapatite nanoparticles is higher compared to toothpaste containing amine fluoride. Therefore, the authors concluded that hydroxyapatite nanoparticles can enhance the remineralization of teeth [29].

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Figure 3: Polymeric Dental Nanomaterials: Antimicrobial Action

Nano Robots

The goal of nanotechnology in the dental industry is to comprehensively examine, control, develop, restore, protect and improve the oral health of patients. This technology is able to significantly change the field of medicine. Orthodontic nano robots are one of the new technologies in the field of dentistry and nano, which can easily control periodontal tissues and allow quick and painless stabilization of the tooth, rotation and change of its vertical position in a few minutes to a few hours [30]. This method has a great advantage compared to other methods that take weeks to months. Usually, nano robots are used in various fields such as aesthetics, oral cancer treatment, oral adhesives, sterilization, bone replacement, etc [31].

The Use of Graphene in Dentistry

Scientists are recently conducting extensive research on graphene-based nanoparticles related to dentistry. Usually, cavities created in teeth are filled with dental material. According to Sina press, these materials are completely in contact with the crevice fluid, saliva and water. Also, these materials are exposed to high chewing force, temperature increase and various abrasions, which cause mechanical failures. According to Sina press, over time dental materials need to be repaired or replaced. Therefore, dental materials with superior properties are required for effective and durable dental procedures [32]. Graphene nanomaterials have unique mechanical, optical, physical and chemical properties that have recently been used in dental research. Graphene is a carbon-based nanomaterial that is a two-dimensional monolayer structure with sp2 hybridized carbon atoms packed in a hexagonal structure. There are many types of graphene nanomaterials, such as multilayer graphene (FLG), ultrathin graphite, graphene oxide (GO), reduced graphene oxide (RGO) and graphene nano sheets (GNS).

These graphene nanomaterials are different from each other due to the number of different layers, surface characteristics and size. According to Sina press, citing azom, in the meantime, graphene oxide (GO) is the most widely used due to its superior properties and has many

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chemically reactive functional groups on its surface that interact with DNA, proteins, facilitates polymers and biomolecules [33]. One of the challenges of dental treatment is the restoration of lost teeth. Some materials used in this process help to grow and regenerate the damaged tissue in the periodontal structure. According to Sina press, the synthetic biomaterials used in this field lack tissue-inducing activities, which slow down the treatment and functional reconstruction in many patients. Graphene oxide (GO) scaffolds used on canine tooth cavities cause bone formation 5 times faster than collagen scaffolds. This graphene material also accelerates the proliferation and differentiation of stem cells in bone cells. Graphene is used in nano medicine as antimicrobial agents. Graphene oxide (GO) is effective in preventing the growth of all dental pathogens. Graphene, in combination with other compounds such as nanocomposite oxide and graphene/zinc, improves the antimicrobial and anti-biological nano membrane properties. Other effects of graphene include its use in dental implants [34]. In the process of implanting a dental implant, bone fiber integration occurs between the biological system of the host and the dental implant. According to Sina press, by using this substance, the speed of the treatment process increases and prevents the accumulation of bacteria. Graphene, which is covered with a titanium layer, has a surface self-healing effect that reduces the possibility of pathogens sticking to the teeth.

Reduce Dental Sensitivity

Researchers from the University of Queensland in Australia have found effective ways to manage tooth sensitivity using nanotechnology. This method helps patients with sensitive teeth to have more pain relief in the long run. According to Sina press, when the tooth enamel is worn down and the tooth dentin is exposed, eating or drinking cold or hot foods can cause a sudden spark of pain. The nanomaterials used in this research quickly block the cavities in the dentin and prevent unpleasant pain [35]. The researchers' approach works faster and lasts longer than current treatment options. Researchers make these materials into a paste, so people with sensitive teeth can simply apply this paste on their teeth and massage it for one to three minutes. According to Sina press, tooth sensitivity is observed in more than 74%, which affects the quality of life. By using this nano paste, people can reduce their tooth sensitivity at home without the need of a dentist. Today, glass ionomer cement is used in dentistry as adhesive cement, flooring material, liner and restorative material. Although this material has special properties such as fluoride release, antimicrobial properties and chemical adhesion to the tooth surface, due to its weaker mechanical properties compared to amalgam and resin composites, it is less welcomed in the field of restorative dentistry.

In recent years, in various studies, in order to improve the mechanical properties of this material, various compounds including various metals, zirconia, various nanoparticles, bioactive glass [36] and wollastonite has been added to this article [37]. Chitosan and titanium dioxide nanoparticles are another category of these compounds that have been used to improve the biological and mechanical properties of glass ionomer [38]. Modifying glass ionomer with chitosan increases antimicrobial properties, fluoride release, compressive strength and also, the combination of titanium dioxide nanoparticles with glass ionomer powder improves its compressive strength, bending and antimicrobial properties. Synergism shows their effect on

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some mechanical and biological properties of ionomer zed glass and further increase of compressive and tensile strength and antimicrobial properties. One of the mechanical features that should be considered in restorative glass ionomer is its adhesion strength to the tooth surface. Glass ionomer adheres to the surface of the tooth by establishing chemical bonds and without the need for any intermediate material. However, its bond strength to the tooth surface shows lower values than resin composite restorations, and it is necessary to increase its bond strength in some way to improve restorations with this material increased the adhesion of ionomer to the tooth and did not affect it in some others. Titanium dioxide nanoparticles did not interfere with the adhesion of glass ionomer to teeth [39]. Regarding the simultaneous use of these two substances in the composition of glass ionomer. As mentioned earlier, some of the mechanical and biological properties of glass ionomer have been improved, but until the current research, there has been no study on its bond strength.

Use of Charged Nanoparticles for Drug Delivery to Teeth

Since part of the tooth enamel has negative charges, these carriers can stick to the surface of the tooth and stay there. Treatment agents that aim to reduce tooth decay are often washed away by saliva and swallowing before they can take effect, but a group of researchers has come up with a way to prevent this. Dental plaque is a thin biological layer that consists of bacteria and is placed in a sticky network of extracellular polymers and strongly adheres to the tooth. The research group, led by Hyun Ko, professor of orthodontics, pediatric dentistry, and community oral health at the University of Pennsylvania School of Dentistry, and Danielle Benoit, assistant professor of biomedical engineering at the University of Rochester, have found a new method that can produce an antibacterial agent in the presence of oral saliva. Remove dental plaques. In relation to this research project, Ko explains: Usually, oral treatments are in temporary contact with the mouth, for example, mouthwash or toothbrushes are in the mouth for a few minutes at most. The problem is how to get the bioactive molecules in place. Further, the formation of oral biofilms can be controlled and even prevented. To deliver the agent to the target sites, researchers created a spherical volume of particles called nanoparticle carrier. They formed the outer coating of positively charged polymers. For the inner part, they protected the drug with hydrophilic polymers that also responded to PH. The outer layer of the carrier can remain on the surface of the tooth due to its positive charges, because a part of the tooth enamel consists of a material with a negative charge.

Discuss

The introduction of nano particles into the field of dentistry has caused significant progress in this field, which includes prevention of caries, improvement of antimicrobial properties of materials, improvement of mechanical properties of materials, etc.

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Nanoparticles have various uses in dentistry, which can be mentioned as follows:

- Application of nanoparticles for their antibacterial effects;
- Application of nano particles in order to investigate their effect on the bond strength of orthodontic bracket and tooth surface;
- Use of nanoparticles to prevent caries;
- The use of nanoparticles in order to investigate their effects on the physical properties of acrylic;
- Use of nanoparticles to make orthodontic adhesives visible;
- The use of nanoparticles to reduce the friction between the wire and the bracket.

According to the studies, all silver nanoparticles, curcumin, titanium oxide, chitosan, zinc oxide, tetravalent ammonium derivatives show good antibacterial properties. Silver nanoparticles added to orthodontic composite reduce bond strength. It seems that curcumin and chitosan nanoparticles do not have a negative effect on bond strength, but Sepiolite particles increase bond strength. Studies show that adding zinc oxide nanoparticles to orthodontic wires reduces the friction between the wire and the bracket. While adding titanium oxide nanoparticles to the bracket increases the friction [40].

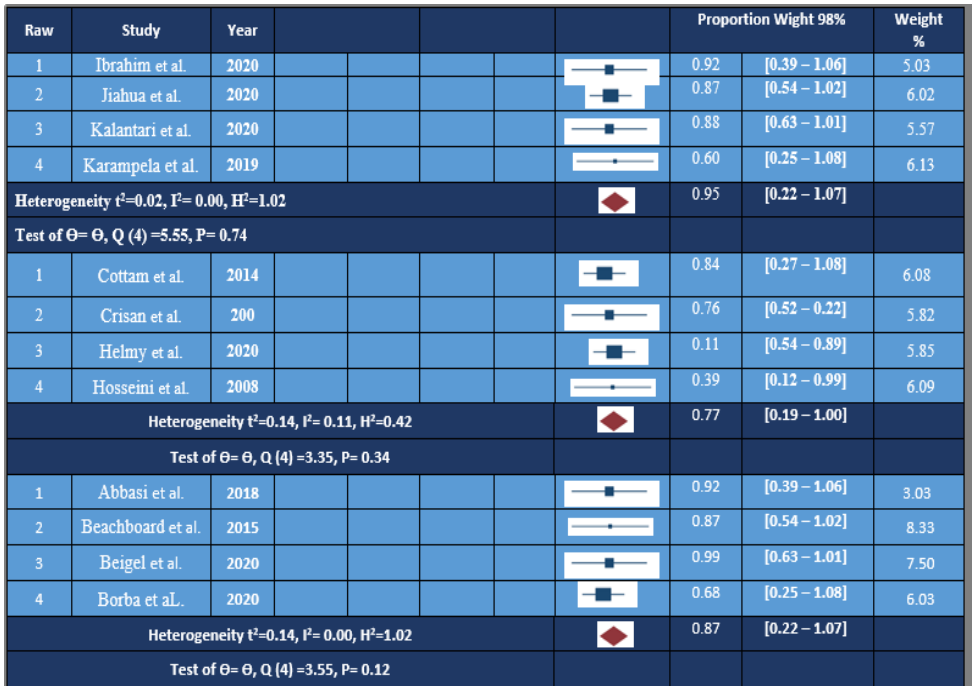

Figure 4: Forest plot showed Nanoparticles in Orthodontics with Surgery Points

One of the important aspects of the application of nanoparticles is their toxicity. Although the evidence in this field is not enough, it seems that nanoparticles are at least not more toxic than normal materials. The accumulation of microorganisms on these materials is always one of the

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foreseeable problems in the use of these materials, especially in orthodontics. To solve this problem, research institute researchers' nuclear science and technology carried out research with the aim of introducing silver nanoparticles into hydroxyapatite composites and creating antimicrobial properties in it. Recent studies have shown that the use of silver nanoparticles in dental composites has less toxicity and more antimicrobial properties than other antibacterial materials [41]. This material is also capable of inducing its antibacterial properties in the dental composite for a longer period of time than other materials. These researchers used the gamma irradiation method to make this nanocomposite, which has advantages such as ease, uncomplicated and clean process mechanism (Figure 5). The way silver ion is released in the nano state is different from silver ion derivatives. Silver nanoparticles act as a reservoir of silver ions, and when these materials are placed in the presence of water and dissolved oxygen, silver ions are gradually released.

Figure 5: Forest plot showed particles in Orthodontics with Surgery Points

This causes the silver ion to be released in a controlled manner and for a longer period of time, and the antimicrobial property is maintained for a longer period of time. To make this product, at first, it was tried by mixing hydroxyapatite and silver nitrate solution, silver ion enters the structure of hydroxyapatite. Then, the prepared silver/hydroxyapatite composite was subjected to gamma ray irradiation. After irradiation and purification steps, silver/hydroxyapatite nanocomposite was prepared. Based on the obtained results, silver nanoparticles with a cubic crystal structure and an average particle size of less than 50 nm are formed in the structure of hydroxyapatite without significant changes in the chemical structure of hydroxyapatite. Also, the test to determine the antimicrobial properties has shown that the prepared nanocomposites have higher antimicrobial properties. Orthodontic force is transmitted to the teeth by brackets. Brackets have different shapes, uses and types. But if we want to divide them in terms of

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gender, brackets are divided into two general types (metal and tooth-colored). Tooth-colored brackets are divided into three types: Plastic, composite, and ceramic brackets. Ceramic brackets are more expensive and cost more, but the advantage of these brackets is that they are less visible because they are tooth-colored. Tooth-colored brackets are more useful for beauty (Figure 6). On the other hand, plastic and composite brackets based on plastic are easily deformed, but have little strength. Also, these brackets change color after some time, while ceramic brackets do not [4].

But the disadvantage of ceramic brackets compared to the other two types is their high cost. On the other hand, because ceramic is fragile, it cannot withstand some forces and it breaks. But when a lot of force is applied to composite and plastic brackets, they deform and do not crush. Another disadvantage is in movements and displacement.

Raw	Study	Year					Proportion Wight 98%		Weight %
1	Hastings et al.	1995					0.64	[0.11 – 1.72]	3.02
2	Watts et al.	1997					0.52	[0.42 – 2.11]	4.00
3	LeGrand et al	2007					0.96	[0.44 – 1.02]	6.32
4	Hung et al	1995					0.65	[0.25 – 0.98]	5.12
Heterogeneity t^2=0.00, I^2= 0.00, H^2=0.9							0.55	[0.34 – 0.58]	1.23
Test of Θ= Θ, Q (4) =3.45, P= 0.77									
1	Hosseini et al.	2008					0.56	[0.11 – 0.66]	1.55
2	Ibrahim et al.	2020					0.26	[0.15 – 0.48]	4.33
3	Kalantari et al.	2020					0.48	[0.19 – 0.55]	6.77
4	Rothan et al.	2020					0.24	[0.17 – 0.29]	3.03
Heterogeneity t^2=0.05, I^2= 0.07, H^2=0.78							0.22	[0.03 – 0.32]	
Test of Θ= Θ, Q (4) =3.01, P= 0.11									
1	Michler et al.	2021					0.77	[0.39 – 1.06]	3.11
2	Chiusano et al.	2020					0.65	[0.54 – 1.02]	6.05
3	Delin et al.	2020					0.73	[0.63 – 1.01]	4.06
4	Gadlage et al.	2010					0.41	[0.25 – 1.08]	7.03
Heterogeneity t^2=0.12, I^2= 0.01, H^2=0.99							0.48	[0.22 – 1.07]	6.03
Test of Θ= Θ, Q (4) =1.45, P= 0.14									

Figure 6: Forest plot showed Nano material Orthodontics with Surgery Points

Friction is discussed in very small points. The friction of brackets made of wires (stainless steel/Ti) or ceramics (alumina, zirconia or magnesium aluminate) is more than other cases. To reduce this friction, a metal layer is passed in the grooves in the bracket to prevent this friction, but no action has been taken to fix the brittleness of ceramic brackets. Therefore, the researchers of Malek Ashtar University with the support of the support fund for researchers and technologists of the Scientific Vice-Chancellor conducted a research project in this field. "Manufacturing orthodontic brackets based on spinel nanocomposites" is the title of this research project. In this study, the researchers of the country used silicon nitride nanoparticles to improve the brittleness of ceramic brackets. Also, the purpose of this project is to make orthodontic brackets based on spinel-Si_3N_4 nanocomposites to improve toughness and impact resistance [43]. The results of this project are used in medicine and orthodontic applications.

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Also, its output results for scratch-resistant surfaces in parts of optical fibers, laser host materials, enclosures for high-pressure arc lamps, solar absorber tubes, night vision goggles, infrared temperature sensors, and replacements for quartz and sapphire in Semiconductors should be used. According to this report, it is common in orthodontic art that metal, plastic or ceramic brackets are placed on the tooth. Of course, to regularize the position of the teeth, arch wire is used throughout this bracket. These brackets must have high mechanical strength against the pressure caused by the tension of the wires along the brackets. However, the bracket composition must be susceptible to mechanical (or chemical) bonding to the tooth. Another aspect to consider is its aesthetic life, especially for adults. Recently, the approach of researchers to ceramics such as magnesium aluminate has been drawn to make dental brackets due to its high strength and transparency in the visible area. But the problem of this ceramic is its low toughness [44]. Nanoparticles such as SiC and Si_3N_4 can be used to improve the toughness of transparent $MgAl_2O_4$ spinel ceramic in the visible range. In many cases of orthodontics, the deviation of the teeth is so much that some of the fibers connecting the teeth to the jaw bone must be surgically cut before starting work, but with the use of new liposomal nanoparticles, the structure of these fibers can be changed with less pain and faster. When these liposomal nanoparticles are placed under the gums, they release collagenase enzymes. These enzymes are activated by the calcium present in the mouth and weaken the collagen fibers connecting the teeth and bones, and in this way, the teeth can be easily corrected by using orthodontic brackets. Compared to conventional surgeries, this method makes the tooth replacement process three times faster. Researchers tested this new method on mice. All mice, like humans, lost some weight after surgery. But those mice that were treated using this enzyme quickly regained their normal weight, which indicates the absence of pain in them.

Changing the Method of Oral Surgery with Nanotechnology

Researchers have developed new liposomal nanoparticles that contain collagenase enzymes and are able to reduce the recovery time and pain caused by jaw and oral surgery. According to Health News, researchers created new liposomal nanoparticles that contain collagenase enzymes and are able to reduce the recovery time and pain caused by jaw and oral surgery. These enzymes can break collagen peptide bonds and have the ability to change the way the fibers connecting the teeth connect to the jawbone. In many cases of orthodontics, the deviation of the teeth is so much that some of the fibers connecting the teeth to the jaw bone must be surgically cut before starting work, but with the use of new liposomal nanoparticles, the structure of these fibers can be changed with less pain and faster.

When these liposomal nanoparticles are placed under the gums, they release collagenase enzymes. These enzymes are activated by the calcium present in the mouth and weaken the collagen fibers connecting the teeth and bones, and in this way, the teeth can be easily corrected by using orthodontic brackets. This method makes the tooth replacement process three times faster than conventional surgeries. Researchers tested this new method on mice. All mice, like humans, lost some weight after surgery. But those mice that were treated using this enzyme quickly regained their normal weight, which indicates the absence of pain in them. The full report of this research has been published in the journal ACS Nano.

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Background Research

Ibrahim and his colleagues added chitosan in volume percentages of 5%, 10%, 25% and 50% to glass ionomer and investigated its effect on the tensile strength of glass ionomer and its antimicrobial properties. They observed that the addition of chitosan improved the antimicrobial properties of glass ionomer against Streptococcus mutans. Also, in the results of the tensile band strength test, it was observed that in the volume percentages of 5% and 10% there was a slight difference between them and the unmodified glass ionomer group, but the volume percentages of 25% and 50% had reduced the tensile band strength of the glass ionomer [45].

In another study conducted by Debnath et al., the adhesion and antimicrobial properties of chitosan-modified glass ionomer were again measured. But this time, only chitosan was tested at a volume percentage of 10%. The antimicrobial property of glass ionomer was improved by the presence of chitosan as in the study of Ibrahim and his colleagues [36] and confirmed the previous studies. But the shear bond strength results showed that chitosan increased the adhesion of glass ionomer significantly (about two times). One of the goals of this research was to investigate the effect of the presence of chitosan alone on the glass ionomer bond strength [2]. The average values obtained from the shear band strength test for the group modified with 10% by volume chitosan was higher than the unmodified glass ionomer group (6.43 MPa vs. 4.63 MPa), but statistically this difference was not significant and it seems that the presence of chitosan alone in the composition of glass ionomer does not have a significant effect on the shear bond strength of this material to the tooth.

Garcia-Contreras and colleagues [7] investigated the mechanical and antimicrobial properties of glass ionomer modified with titanium dioxide nanoparticles. After adding titanium dioxide nanoparticles to glass ionomer, they concluded that the antimicrobial property of glass ionomer increases. Also, the addition of titanium dioxide nanoparticles does not interfere with the shear band strength of glass ionomer [40-55]. They also concluded that the glass ionomer modified with these nanoparticles shows an increase in tensile and compressive strength values.

CONCLUSION

Nanotechnology is the ability to produce new materials, tools and systems by taking control at the molecular, atomic level and using the properties that appear at those levels. With the entry of nanotechnology into the field of human knowledge and its use in the development of biological and medical sciences, dental science has not been left without this technology. In this sector, nanotechnology is used in the three areas of dental materials, dental health and dental equipment, and in short, it can be used in nanocomposites in the manufacture of restorative materials, nano ceramics in the manufacture of artificial teeth, nano coatings on dental implants, nano fluorides in toothpastes and silver nanoparticles. Mentioned in mouthwashes. Researchers in a research titled "Nano technology; its role and application in dentistry" have brought, the advancement of nanotechnology in the field of dental materials is of particular importance; because the trend of patients towards aesthetic treatments, beautiful and tooth-colored restorative materials, including dental ceramics, has found many uses in

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today's dentistry. New developments in the field of nanotechnology to solve these needs have received much attention.

It is hoped that by using this technology, the problems that exist in various fields of dentistry will be solved. A large number of nanotechnologies enabled products have become commercial products; the transfer of emerging and new nano-enabled technologies from the laboratory to commercial products depends on many factors. The application of nano coatings in this field includes a wide range, including dental instruments, implants, parts and equipment. The presence of electrolytic fluids in the human body has caused the internal environment of the body to be very corrosive and active even for titanium and stainless-steel alloys. This issue necessitates the existence of coatings that have suitable mechanical properties and are extremely chemically neutral. One of the common examples in this case is dental implants. TiN nano coating has found its place in the engineering industry due to its unique properties. These nano coatings are used in many dental instruments. One of the problems of plaques that are used in orthodontics today is their hygiene, which must be cleaned regularly, otherwise the possibility of microbial plaque accumulation increases. Since silver nanoparticles have high germicidal and bactericidal properties, they can be used in the manufacture of dental materials.

In this method, first, silver nanoparticles are prepared by chemical reduction method in the presence of acrylic reducing agent. Prepared nanoparticles are added to acrylic liquid phase and added to methyl methacrylate powder with certain proportions and molded, and finally prepared dental nanocomposite can be used as the basis of dental materials, which has antibacterial properties and high strength. Among the advantages of using nanoparticles in tooth restoration, we can mention the production of fillers with high polish, minimal polishing time, stability and resistance of materials to mechanical shocks, minimal adhesion to tools, and the possibility of accurate color matching. Zirconium oxide nanoparticles, which have high strength and transparency to light, but prevent the passage of X-rays, are used in dentistry. Nanoparticles called DM have wide applications and high efficiency. DM is a very pure silica gel whose particles do not stick together and is non-porous and has a high volumetric weight. Due to these features, it is possible to use these materials in dentistry as fillers. A product made of silicon nanoparticles, which, when used in dental nanocomposites, cause more hardness, increased bending strength, transparency and create a more attractive appearance. In addition, the use of these nanoparticles reduces the fragility of filler materials by 50%. Therefore, with the entry of nanotechnology into the field of human knowledge, the field of dentistry has not been left without this technology. Because the resulting new materials are much smaller; As a result, their use in dental restorations will lead to better results. This technology is used in various sectors including dental materials, dental health and dental equipment. Many products empowered with nanotechnology have also become commercial products and have entered the market now. New developments in the field of nanotechnology to solve the needs of people have been very much considered. It is hoped that by using this technology, the problems that exist in various fields of dentistry will be solved.

Due to the importance of teeth and dentistry, countless researches are conducted in the world to solve dental problems. Nano technology is one of the technologies that have been released

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in the last few years and has been able to create profound changes in the field of research and production of various products. Nanotechnology in dentistry is used in three areas: Dental materials, dental health (toothpaste and toothbrush) and dental equipment. Nano coatings on dental implants, nano fluorides in toothpastes and he mentioned silver nanoparticles in mouthwashes. The progress of nanotechnology in the field of dental materials is of special importance; because the tendency of patients towards beauty treatments, beautiful and tooth-colored restorative materials, including dental ceramics, has found many uses in today's dentistry. In recent years, with the progress achieved in the field of preparing ceramics with more desirable properties, ceramics in various branches of dentistry such as restorative dentistry, dental prostheses, orthodontics, dental implants (tooth implants) and surgery have been widely accepted. But the new science has not only created a revolution in the field of dental ceramics. The use of nano technology in the manufacture of dental materials has also increased the strength of new materials. In the field of manufacturing dental materials, important factors must be considered in order to obtain the expected quality of the materials. The materials used in dentistry are evolving rapidly. One of the problems in dentistry is the materials used. The materials used in dentistry must have high resistance and have a beautiful appearance. Poorly formulated dental materials cause discomfort, side effects, and increase health care costs.

References

1) A Nurmeksela, et al., Relationships between nursing management, nurses' job satisfaction, patient satisfaction, and medication errors at the unit Level: A correlational study. Research Square 2020; 1 (1): 1-22.

2) AR Hosseini Khalili, et al. Angiotensin-converting enzyme genotype and late respiratory complications of mustard gas exposure. BMC Pulm Med. 2008; 8(1):15.

3) B Shakiba, et al., Medical Workplace Civility Watch: An Attempt to Improve the Medical Training Culture, Journal of Iranian Medical Council, 2022, 5 (1), 227-228

4) F Karimzadeh, et al., Comparative evaluation of bacterial colonization on removable dental prostheses in patients with COVID-19: A clinical study, The Journal of Prosthetic Dentistry, 2021, 1-3

5) F Mirakhori, M Moafi, M Milanifard, A Asadi rizi, H Tahernia, Diagnosis and Treatment Methods in Alzheimer's Patients Based on Modern Techniques: The Orginal Article, Journal of Pharmaceutical Negative Results, 2022, 13 (1), 1889-1907

6) F Najafi, et al., the Relationship between General Health and Quality of Work Life of Nurses Working in Zahedan Teaching Hospitals. Iranian J of Rehabilitation Research in Nursing 2018; 4 (2): 53-9.

7) H Kalantari, et al., Determination of COVID-19 prevalence with regards to age range of patients referring to the hospitals located in western Tehran, Iran. Gene reports. 2020; 21: 100910.

8) H Tahernia, et al., Diagnosis and Treatment of MS in Patients Suffering from Various Degrees of the Disease with a Clinical Approach: The Original Article, Journal of Pharmaceutical Negative Results, 2022, 13 (1), 1908-1921

9) I Karampela, M Dalamaga, Could Respiratory Fluoroquinolones, Levofloxacin and Moxifloxacin, prove to be Beneficial as an Adjunct Treatment in COVID-19? Archives of medical research. 2020; 51(7):741-2.

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/W49ST

10) JP Montani, Vliet VB. General physiology and pathophysiology of the renin-angiotensin system. Angiotensin Vol. I: Springer; 2004: 3-29.

11) K Goyal, et al., Fear of COVID 2019: First suicidal case in India! Asian J of psychiatry 2020; 49: 101989.

12) M Aminzadeh, et al., The Frequency of Medication Errors and Factors Influencing the Lack of Reporting Medication Errors in Nursing at Teaching Hospital of Qazvin University of Medical Sciences, 2012. J of Health 2015; 6 (2): 169-79.

13) M Barzideh, A Choobineh, Tabatabaei S. Job stress dimensions and their relationship to general health status in nurses. Occupational Medicine 2012; 4 (3): 17-27.

14) M Mileski, et al., The impact of nurse practitioners on hospitalizations and discharges from long-term nursing facilities: a systematic review. Healthcare 2020; 8 (2): 114-34.

15) MGS Borba, et al. Effect of high vs low doses of chloroquine diphosphate as adjunctive therapy for patients hospitalized with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection: a randomized clinical trial. JAMA network open. 2020; 3 (4): e208857-e.

16) MJ Gadlage, et al., Murine hepatitis virus nonstructural protein 4 regulates virus-induced membrane modifications and replication complex function. J Virol, 2010. 84(1): p. 280-90.

17) N Alrabadi, et al. Medication errors: a focus on nursing practice. J of Pharmaceutical Health Services Research 2021; 12 (1): 78-86.

18) N Asadi, et al., Investigating the Relationship between Corona Anxiety and Nursing Care Behaviors Working in Coronary Referral Hospitals. IJPCP 2020; 26 (3): 306-19.

19) N Zaimzadeh, et al., Comparison of vitamin D dietary intake among four phenotypes of polycystic ovary syndrome and its association with serum androgenic components, Razi Journal of Medical Sciences, 2018, 25 (2), 87-96

20) N Zaimzadeh, et al., The study of dietary intake of micronutrients in four phenotypes of polycystic ovary syndrome separately based on Rotterdam criteria, Razi Journal of Medical Sciences, 2018, 25 (3), 59-68

21) S Mahmoodi, et al., General health and related factors in employed nurses in Medical-Educational Centers in Rasht. JHNM 2015; 25 (1): 63-72.

22) S Musaei, The Effect of Pregnancy on the Skin, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 2023, 2 (1), 17-23

23) S.H Salehi, K As'adi, S.J Mousavi, S Shoar, Evaluation of Amniotic Membrane Effectiveness in Skin Graft Donor Site Dressing in Burn Patients, Indian J Surg, 2015 Dec;77(Suppl 2):427-31.

24) S.H Salehi, M.J Fatemih, K Aśadi, S Shoar, A Der Ghazarian, R Samimi, Electrical injury in construction workers: a special focus on injury with electrical power, Burns, 2014 Mar;40(2):300-4.

25) TSH Abadi, et al., Depression, stress and anxiety of nurses in COVID-19 pandemic in Nohe-Dey Hospital in Torbat-e-Heydariyeh city, Iran. J of Military Med 2020; 22 (6): 526-33.

26) YA Helmy, et al., The COVID-19 pandemic: a comprehensive review of taxonomy, genetics, epidemiology, diagnosis, treatment, and control. Journal of Clinical Medicine. 2020; 9(4):1225.

27) Z Malekpour-Dehkordi, M Nourbakhsh, M Shahidi, N Sarraf, R Sharifi. Silymarin diminishes oleic acid-induced lipid accumulation in HepG2 cells by modulating the expression of endoplasmic reticulum stress markers. Journal of Herbal Medicine. 2022; 33:100565.

28) M Mahmoudinezhad, S Khosravaniardakani, L Saljoughi Badelou,et al., The integrative panel of fatty acid desaturase-2 (FADS2) rs174583 gene polymorphism and dietary indices (DQI-I and HEI) affects cardiovascular risk factors among obese individuals, BMC Endocrine Disorders, 2023, 23 (1), 1-12

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/W49ST

29) S Khosravaniardakani, MH Anbardar, S Khodamoradi, S Peyravi, Epidemiological and Pathological Characteristics of Renal Cell Carcinoma with Outcome Evaluation: A Single Center Study from Shiraz, Iran, International Journal of Medical Investigation, 2022, 11 (2)

30) S Khosravaniardakani, Vaping Products And Asthma In Youths: A Review Of The Prospective Study, International Journal of Medical Investigation, 2022, 11 (1)

31) SAH Abadi, R Atbaei, M Forouhi, HG Falaverjani, R Moazamiyanfar, et al., Preventive and Therapeutic Approaches in Medical Departments During the COVID-19 Pandemic, Kindle, 2022, 2 (1), 1-216

32) SA Ahadiat, M Shirazinia, S Shirazinia, S Garousi, M Mottahedi, AB Jalali, et al., Role of Telemedicine in Management of Patients During the COVID-19 Pandemic, Kindle, 2022, 2 (1), 1-191

33) S Khosravaniardakani, DO Bokov, T Mahmudiono, SS Hashemi, N Nikrad, et al., Obesity accelerates leukocyte telomere length shortening in apparently healthy adults: a meta-analysis, Frontiers in nutrition, 2022, 9

34) S Khosravaniardakani, The Effect of Cigarette and Its Nicotine Content on The Heart Health, International Journal of New Chemistry 9 (Spring Special), 2022, 102-107

35) S Birmangi, A Review of the Effect of Corona on the Human Brain – Short Review, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 2022, 1 (3), 80-87

36) S Margy, A Review of the Effect of Brain imaging- Short Review, Eurasian Journal of Chemical, Medicinal and Petroleum Research, 2022, 1 (3), 88-99

37) AA Esmaeilzadeh, MM Yaseen, U Khudaynazarov, ME Al-Gazally,et al. Recent advances on the electrochemical and optical biosensing strategies for monitoring microRNA-21: a review (vol 14, pg 4449, 2022), ANALYTICAL METHODS, 2022, 15 (1), 132-132

38) AA Esmaeilzadeh, M Kashian, HM Salman, MF Alsaffar, et al., Identify Biomarkers and Design Effective Multi-Target Drugs in Ovarian Cancer: Hit Network-Target Sets Model Optimizing, Biology, 2022, 11 (12), 1851

39) AA Esmaeilzadeh, S Rasoolzadegan, AR Arabi, et al., Cytotoxic study of green synthesized pure and Ag-doped α-Fe2O3 nanoparticles on breast cancer (MCF-7) cell line, Nanomedicine Research Journal, 2022, 7 (4), 370-377

40) AA Esmaeilzadeh, Mohammad Ghenaat, Pisheh Sanani, et al., Study of Silybinin Plant Effective Substance for use in targeted liposomal nanoparticles in the treatment of liver cancer, Archives of Pharmacy Practice, 2020, 11 (1), 35

41) H. Daneste, A. Sadeghzadeh, M. Mokhtari, et al., Immunoexpression of p53 mutant-type in Iranian patients with primary and recurrence oral squamous cell carcinoma, European Journal of Translational Myology, 2023, 33 (1), 1-7

42) Mohsen Nabiuni, Saeedeh Sarvarian, Primary cerebellar tuberculoma in Arnold-Chiari malformation mimicking posterior cranial fossa tumor: the first report , Global spine journal,2011,1(1), 019-021

43) Mohsen Nabiuni, Saeedeh Sarvarian, Postoperative Visual Loss After Spine Surgery: A Case Report, Journal of Neurosurgery Quarterly,2014,24(2), 94-97

44) Masoumeh Najafi, Amin Jahanbakhshi, Sebastiano Finocchi Ghersi, Lucia Giaccherini, Andrea Botti, Francesco Cavallieri, Jessica Rossi, Federico Iori, Cinzia Iotti, Patrizia Ciammella, Mohsen Nabiuni, Marzieh Gomar, Omid Rezaie, Salvatore Cozzi, Clinical Effects of Immuno-Oncology Therapy on Glioblastoma Patients: A Systematic Review, Journal of Brain Sciences,2023,13(2), 159

45) Leart Berdica, Erisa Kola, Daniela Nakuci, Edlira Horjeti, Mehdi Alimehmeti, Cardiac hemangioma presenting as a primary cardiac tumor,Journal of Cardio-Oncology,2023,9(1),1-4

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/W49ST

46) Juna Musa, Edlira Horjeti, Ali Guy, Kristi Saliaj, Diamant Shtiza, Elton Ceka, Dorina Musa, Loran Rakovica, Diagnosis and Management of Genetic Derivation 22 and 11 Chromosome-Emanuel Syndrome in 10-Year Old Boy, Journal of Pediatrics, Perinatology and Child Health,2020,4(3),52-57

47) Juna Musa, Loran Rakovica, Luela Hallunovaj, Edlira Horjeti, A Case Report On Intraocular Cystocercosis and the Occurrence of A Live Free Floating Cyst in the Anterior Chamber of the Eye, Journal of Archives of Clinical and Medical Case Reports,2020,4, 774-778

48) Erisa Kola, Leart Berdica, Teona Bushati, Alfred Aga, Ali Guy, Ina Kola, Edlira Horjeti, Klejda Hoxha, Fareeha Nasir, Juna Musa, Unusual Histological Variant of a Primary Osseous Tumor of the Jaw in a 27-Year-Old Female: Review of the Literature and Case Presentation, ASMS,2020,4(5), 45-48

49) Daniela Nakuci, Erisa Kola, Edlira Horjeti, Ina Kola, Blerona Shaipi, Juna Musa, Ali Guy, Mehdi Alimehmeti, Ovarian Hemangioma Presented as an Incidental Ovarian Mass: A Rare Case Report along with Literature Review, Archives of Clinical and Medical Case Reports,2020,4(5), 760-765

50) Juna Musa Elona Dado, Edvin Dado, Juliana Karanxha, Cory Greguske, Elizana Zaimi Petrela, Efrosina Kajo, Mrunal Teja Chinthapalli M, Edlira Horjeti, Fjolla Hyseni, Sepideh Jahanian, Blina Abdullahu, Mohammad Abubaker SIDDIQUE, Prophylaxis of Atrial Fibrillation After Isolated On-pump Coronary Artery Bypass Surgery with Postoperative Intravenous Magnesium Sulfate, Acta Scientific Medical Science,2022,7(1), 122-136

51) Erisa Kola, Arben Gjata, Ina Kola, Ali Guy, Ronny Khadra, Juna Musa, Valbona Biba, Vladimir Filaj, Edlira Horjeti, Daniela Nakuci, Anisa Cobo, Kristi Saliaj, Mehdi Alimehmeti, Fjolla Hyseni, Abu Bakar Siddik, Samar Ikram, Corrigendum to 'Ectopic thyroid tissue in the anterior mediastinum along with a normally located gland' (Radiology case reports 16 [2021] 3191-3195), Radiology Case Reports,2022,17(3),1032

52) Erisa Kola, Ina Kola, Migena Brati-Dervishi, Ali Guy, Edlira Horjeti, Violeta Dajci, Juna Musa, Daniela Nakuci, Occurrence of Cutaneous Melanoma in a Patient with Previous History of Uveal Melanoma. Same Embryology, Different Driver Mutation Landscape, Journal of Surgery and Research,2020,3(2), 140-146

53) Kiyan Heshmat-Ghahdarijani , Roya Modaresi et al, Reducing Cardiac Steatosis: Interventions to Improve Diastolic Function: A Narrative Review,National Library of medicine, 2023 Aug;48(8):101739

54) Ali Rezazadeh Roudkoli , et al , Setayesh Sotoudehnia Korani 4*,Clinical profiles of patients with myocardial infarction without obstructive coronary artery disease in Iran,Journal of preventive Epidemiology, 2022;7(2): e26167.

55) Sina Bakhshaei, Bina Bakhshaei,et al, Impact of metformin on hypertension; current knowledge, Journal of Renal Endocrinology, 2022;8:e25067