Research Bulletin
Vol 3, Issue 3 (Jul-Sept 2016)

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Nanotechnology: Application in Dentistry

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Nanotechnology has revolutionised the field of science and technology. It is the production of functional materials and structures in the range of 0.1-100 nm—the nanoscale—by various physical and chemical methods and also known as molecular nanotechnology or molecular engineering. The interest in using nano-materials stems from the idea that they can be used to manipulate the structure and properties of the materials. Nanotechnology is of great interest in biomaterials engineering and the development of dental materials. Nano-particles have been found to be of much use for the controlled release of drugs and other bioactive compounds. It should act as drug-delivery and drug-targeting systems, due to small in size they are not recognised by the human body, migrate through cell membranes and are able to pass through blood-brain barriers. The intrusion of a nano-material in the body triggers substrate effects at the nanoscale level at which structural components of biological systems are built, thus encouraging a strong affinity between molecules. Biomaterial scaffolds can be manipulated by nanotechnology and constructed into specific geometrical and topological structures and bring improved properties such as mechanical (stronger), physical (lighter and more porous), chemical reactivity (more active and corrosive), enhanced biocompatibility, contact guidance, reduce friction and therefore wear for joint applications and promoting tissue growth around the implant. The development of three dimensional nano-fibrous scaffolds using a phase-separation technique from biodegradable synthetic polymers avoids the concern of pathogen transmission and immuno-rejection. The nano-size electrospun fibres provide improved applications such as periodontal regeneration, dental composite reinforcement, wound healing, cell attachment and proliferation of cells and fibroblasts.

Nano-scope particles have more similarities to natural tooth as far as crystal size is concerned. Additionally, the high surface area of the nano-spicific particles would offer a good mechanical interlocking with the polymer matrix. This is true for purpose-designed nano-structures, which can be used to produce low shrinkage, high wear resistance and biocompatibility of the dental composite. The fundamental application is the resistance of nano-particles filled materials to the loss of substance during the propagation of micro-fracture through cyclic fatigue loading. It is also interesting with regard to developing biocompatible or bioactive materials for dental implants and bioceramics. Inorganic nano-particles are hard and dense and these characteristics make them interesting for improving a material’s
The nano-particles are also characterised by a large surface area that increases the bond strength between the resin and the fillers. Due to large surface area, the particles show thixotropic thickening effect, low viscosity and improved the handling properties. These nano-fillers can contribute to increase the modulus of elasticity and are useful as starting compounds for the synthesis of new dental ceramics composites. Furthermore, nano-fillers also show smooth surface effects and volume effects as well as high optical properties. In dental bonding agents, the nano-fillers increased adhesion to enamel and dentine and improved marginal integrity, increased abrasion resistance and surface hardness.

However, there are few concerns related to incorporation of these nano-particles in dental restorative materials i.e. the high content loading of nano-particles into the organic matrix results in aggregation of the filler particles and porosity, which affect the mechanical properties of the resulting material. Furthermore, the major problem is the dispersion and strong interfacial combination between the nano-fillers and the matrix. Therefore, surface grafting of nano-particles during in situ synthesis can provide a solution. It is known that covalent linkage of polymer chains to the nano-fillers is one of the effective approaches to improve the dispersability and the combination of the polymer matrix and the nanoparticles. These covalently-linked, high surface area nano-particles would have potentials in dental applications because of their capability to have tailor-made properties.

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**Research News**

**Students’ Research Grant**

The Vice Deanship of Postgraduate Studies and Scientific Research has started accepting proposals for the Students’ Research Grant for 2016 G. All proposals should be submitted to VDPG secretary as a hard and soft copy. The deadline for submission is 1st Nov, 2016.
Composite restorations are widely used worldwide, but the polymerization shrinkage is their main disadvantage that may lead to clinical failures and adverse consequences. This review reports, currently available in vitro techniques and methods used for assessing the polymerization shrinkage. The focus lies on recent methods employing three-dimensional micro-CT data for the evaluation of polymerization shrinkage: volumetric measurement and the shrinkage vector evaluation through tracing particles before and after polymerization. Original research articles reporting in vitro shrinkage measurements and shrinkage stresses were included in electronic and hand-search. Earlier methods are easier, faster and less expensive. The procedures of scanning the samples in the micro-CT and performing the shrinkage vector evaluation are time consuming and complicated. Moreover, the respective software is not commercially available and the various methods for shrinkage vector evaluation are based on different mathematical principles. Nevertheless, these methods provide clinically relevant information and give insight into the internal shrinkage behavior of composite applied in cavities and how boundary conditions affect the shrinkage vectors. The traditional methods give comparative information on polymerization shrinkage of resin composites, whereas using three-dimensional micro-CT data for volumetric shrinkage measurement and the shrinkage vector evaluation is a highly accurate method. The methods employing micro-CT data give the researchers knowledge related to the application method and the boundary conditions of restorations for visualizing the shrinkage effects that could not be seen otherwise. Consequently, this knowledge can be transferred to the clinical situation to optimize the material manipulation and application techniques for improved outcomes.

BACKGROUND AND AIM: Postoperative pain is a potential adverse side effect of oral surgeries, and attempts should be made to prevent or minimize it. This study compared the efficacy of preemptive ibuprofen and dexamethasone protocol on pain prevention or control after surgical implant placement. METHODS: This prospective, double-blind, parallel-group, placebo-controlled, randomized clinical trial included 117 dental implant patients. The patients were assigned to receive one of three different protocols: 1) 600 mg ibuprofen 1 hour before surgery and another 600 mg 6 hours after the first dose; 2) 4 mg dexamethasone 1 hour before surgery and another 4 mg 6 hours after the first dose; or 3) placebo. Rescue medication (1000 mg acetaminophen) was made available to each patient, and they were instructed to take it as necessary. Pain intensity was evaluated via a 101-point numeric rating scale and a visual analogue scale, and discomfort was evaluated using a 4-point verbal rating scale hourly for the first 8 hours after surgery and three times a day for the following 3 days. RESULTS: Both ibuprofen and dexamethasone significantly reduced pain (Kruskal-Wallis; p < 0.05) up to 3 days after surgery, and discomfort (p < 0.05) up to 2 days after surgery compared to placebo treatment. Both treatments reduced the number of painkillers taken and increased the time before the first painkiller was taken (p < 0.01). CONCLUSIONS: Steroidal dexamethasone is as effective as non-steroidal ibuprofen for preventing or controlling postoperative pain and discomfort after surgical implant placement.

BACKGROUND AND AIM: The role of nutrition in periodontal health is an important aspect of dental care. This article updates the current knowledge on how nutrition affects periodontal health.

METHODS: This review included studies that examined the relationship between nutrition and periodontal health, focusing on the impact of dietary factors such as sugar, fiber, and vitamins on periodontal disease. The review also evaluated the role of antioxidants and specific nutrients in the prevention and treatment of periodontal disease.

RESULTS: The review found that a diet high in sugar and low in fiber increases the risk of periodontal disease. Antioxidants such as vitamin C and E have been shown to protect against periodontal disease. The review also highlighted the importance of vitamin D in maintaining oral health.

CONCLUSIONS: Nutrition plays a critical role in periodontal health. A healthy diet rich in fiber, vitamins, and antioxidants can help prevent and treat periodontal disease.
Abstract

Periodontal health is influenced by a number of factors such as oral hygiene, genetic and epigenetic factors, systemic health, and nutrition. Many studies have observed that a balanced diet has an essential role in maintaining periodontal health. Additionally, the influences of nutritional supplements and dietary components have been known to affect healing after periodontal surgery. Studies have attempted to find a correlation between tooth loss, periodontal health, and nutrition. Moreover, bone formation and periodontal regeneration are also affected by numerous vitamins, minerals, and trace elements. The aim of this review is to critically appraise the currently available data on diet and maintenance of periodontal health and periodontal healing. The effects of nutritional intervention studies to improve the quality of life and well-being of patients with periodontal disease have been discussed.


Abstract

**Background:** Faculty members’ involvement in research ensures timely transfer of up to date knowledge and helps train students in the use of evidence based approach to clinical practice. Less publications and citations signify a problem in research translation and impact and reflect on the ability of faculty members to optimally fulfill their role. **Objectives:** To assess gender differences in authorship collaboration patterns among a group of faculty members in a dental school in a developing school. **Methods:** A database was developed to include the publications of faculty members in the Faculty of Dentistry, Alexandria University, Egypt who publish internationally. Information was collected about each faculty member’s international publications, his/her co-authors and their h-index. Social network analysis (SNA) was used to a co-authorship network. Using Gephi software, networks’ parameters were calculated including number of nodes (co-authors) and edges (collaborations), degree (number of collaborators an author is connected to), network density (ratio of actual to potential collaborations), number of connected components (co-authorship groups) and average path length (average number of authors connecting two co-authors). Gender differences were compared. **Results:** Women faculty members formed 15.9% of authors publishing internationally with the network including publications that were cited 7464 times. Exclusively male collaboration produced 70.1% of all network citations and exclusively female collaborations produced 5.8%. Same gender collaborations resulted in fewer collaborator per author among women than among men (degree= 2.567 and 5.119). Subnetworks including only women faculty members were fewer and denser than those formed by men only. Most authors with high h-index were men. However, some high h-index women formed the nucleus of research groups that were mostly formed of high h-index men with few connections. **Conclusions:** Women formed a smaller portion of authors publishing internationally and consequently had fewer citations whether collaborating exclusively with other women or with a mix of women and men. The co-authorship patterns of women faculty members in this school may be responsible for their lower impact on research. Promoting opportunities for international collaborations can potentially reduce the gap in number of publications and citations between men and women faculty members.


Abstract

Accurate diagnostic imaging is a key factor for dental specialties, especially in periodontics, for diagnosis and treatment planning. Recent developments and advances in innovative imaging technologies have added a third dimension to the conventional 2D imaging in maxillofacial (Head & Neck) areas of clinical dentistry. It makes for practical and common sense if all the users of imaging play a responsible part in getting their imaging exams interpreted with a formal report both from patient safety and clinician liability perspective. It’s hoped that advances in imaging technologies will keep on adding onto the quality of care and quality of life of our patients.

Abstract

PURPOSE: Control of Streptococcus mutans can prevent caries in high-risk preschool children. The purpose of this study was to assess the effect of casein phosphopeptide amorphous calcium phosphate (CPP-ACP) on Streptococcus mutans in the plaque of high-risk preschool children. METHODS: A triple blind, randomized, controlled clinical trial included 40 healthy three- to five-year-olds with at least one white spot lesion. They were randomized into test (daily applications of GC Tooth Mousse:CPP-ACP) and control groups (placebo mousse). Both groups received health education. Plaque samples were collected at baseline and after 15 days and cultured on Mitis Salivarius Agar. Percent reduction in S mutans count was calculated and compared between groups using t-test. RESULTS: Percent reduction of S mutans in the test group was slightly higher than in the control group (59 percent and 52 percent) but not significantly different after 15 days (P=0.27), with both groups showing a significant reduction from baseline (P<0.001). CONCLUSIONS: Casein phosphopeptide amorphous calcium phosphate reduced Streptococcus mutans in the plaque of preschool children with noncavitated lesions after two weeks of daily application compared to baseline. It was not, however, significantly different from the reduction occurring after only a single session of health education.


Abstract

The risk of dental trauma may increase during sports participation. The purpose of this study was to evaluate the knowledge, attitude, and practices of sports participants concerning sports-related dental trauma and associated emergency/preventive practices. The study included 124 male subjects over 18 years of age participating in contact and non-contact sports in three clubs in the Eastern Province, Saudi Arabia. A questionnaire was used to assess past experience of dental trauma related to sports in addition to the use of a mouth guard and knowledge of related emergency procedures. Outcomes were compared between individuals practicing direct and non-direct contact sports. One third of the participants had experienced dental trauma while playing sports, mostly crown fracture, mobility, and avulsion. Their knowledge of first aid and emergency procedures was inadequate. A significantly higher proportion of non-direct contact sport participants sought the help of a dentist for themselves or others (P = 0.04 and 0.003, respectively). Only 33.9% used mouth guards, with higher odds of mouth guard use associated with participating in direct contact sports and believing a tooth can be lost during sports practice (odds ratio = 5.59 and 5.37, respectively). Educational programs are needed to increase the awareness in sports participants of the risk of dental trauma during sports participation, to improve their knowledge of first aid procedures, and to increase the use of mouth guards.


Abstract

The aim of the present micro-computed tomography (Micro-CT) analysis was to compare the quality of obturation in the apical third of the root with the warm vertical compaction (WVC) and single matching tapered sized cone (SMTSC) techniques. Mesial roots of 16 freshly extracted mandibular first molar teeth (with a total of 32 canals) were used. Canals in each mesial root were shaped to a size F3 Protaper and were randomly assigned to either continuous wave vertical compaction or single match tapered size cone technique. Volume of voids and gaps in the obturated roots were measured using micro-CT scanning at 1, 3, and 5 mm from the apex of the root. There was no statistically significant difference in the volume of voids measured at 1 mm (p > 0.05), 3 mm (p > 0.05) and 5 mm (p > 0.05) filled with either WVC and SMTSC techniques. The quality of obturation in the apical third of the root with the WVC and SMTSC techniques is comparable.
Abstract

Objective: To compare oral hygiene practices and self-reported oral health problems among smoker and non-smoker male high school students in Dammam, Al-khobar and Dhahran, Saudi Arabia. Materials and methods: Cross sectional study design was employed. The study sample (453) was calculated and participants were randomly selected from public high schools. Pilot tested questionnaire was distributed among participants of the study. Descriptive and analytical statistics generated using SPSS version 22. Statistical significance involved using a p-value of <0.05. Results: The prevalence of smoking among teenagers (15–19 years) was about 20.2%. Almost 61.9% (197) of non-smokers had excellent grades compared to 42% (33) of smokers. About 64.5% (258) of the respondents used tooth brushing and 62.5% (244) used miswak and 23.6% (91) of them visited dentist for regular checkup. The comparison of oral hygiene practices between smokers and non-smokers revealed no statistically significant differences. Almost half of the teenagers had bleeding gums and tooth sensitivity, and were dissatisfied with the appearance of their teeth. Self-reported tooth sensitivity was higher among smokers (64%) compared with non-smokers (43%) (p-value 0.001). Similarly, more smokers exhibited dryness of mouth than non-smokers and the difference was statistically significant (p-value 0.007). Conclusion: There is high prevalence of smoking among adolescents. No significant differences were observed between smokers and non-smokers regarding oral hygiene practices. However, tooth sensitivity and dryness of mouth were more common in smokers than non-smokers. Smoking cessation programs should be introduced in schools.


Abstract

A material is considered to be bioactive if it stimulates an appropriate biological reaction in the body and results in the formation of a bond with the tissue. Bioactive glass (BG) are currently being used for numerous clinical applications which include their use as bone grafts, as a coating material for dental implants, as topical endodontic disinfectants, and for the treatment of dentin hypersensitivity. BG’s contain a great potential for various clinical applications and with their current uses and the amount of research being carried out on them, a positive and bright future of BG’s can certainly be anticipated.


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