SHAPING THE FUTURE OF DENTAL EDUCATION:

THE IMPACT OF NEW TECHNOLOGICAL AND SCIENTIFIC DISCOVERIES ON TRADITIONAL DENTAL EDUCATION

Workshop on Scientific Discoveries: summary of surveys, posters, literature and checklist proposal for selecting and integrating an innovation into everyday practice

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CURRENT TRENDS IN SCIENTIFIC DISCOVERIES

• POSTERS
• SURVEY
• LITERATURE REVIEW
POSTERS

3 out of 19 regarding scientific innovations:

• Moving forward from 3D to 4D printing in dentistry
• Nanomedicine in dentistry science and education
• Knowledge of biostatistics in a group of dental postgraduate students
MOVING FORWARD FROM 3D TO 4D PRINTING IN DENTISTRY

4D printing, using self-adjusting materials, is an example of scientific discovery that opens new perspectives.

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Nanomedicine in Dentistry: Science and Education

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Introduction

In recent years, engineered nanoparticles have raised substantial interest due to their possible medical applications in vaccination, diagnostic imaging procedures, oncology, anti-infective or advanced delivery of drugs. Nanoparticles are generally safe, may be administered, cost-effective and most importantly, they have the ability to control the delivery of drugs such as small molecules, proteins and DNA.

In dentistry, drug loaded nano-pharmaceuticals have been extensively utilized over the past decade and are studied in almost all dental related fields such as endodontic therapy, dental caries, dental materials, dental implants or periodontology. Nanomaterials designed for the field of oral health, such as nanofibers, nanotubes, and nanowires, are at the core of efforts to develop a variety of ways how delivering active agents for local delivery becomes possible in treating periodontal diseases, dental caries or periodontal pockets.

It is obvious that nanotechnology is currently transforming many research and clinical approaches in biological sciences and that dentistry too follows this trend. In this light dental faculties should incorporate these findings in their education programs to ensure that students, future dentists and patients are aware of the impact that nanomedicine has on the dental field.

Nanoparticles used in Dental Sciences

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>APPLICATIONS</th>
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</thead>
<tbody>
<tr>
<td>Nanoparticles</td>
<td>Nanotechnology and biodiversity conservation (e.g., anti-microbial agents)</td>
</tr>
<tr>
<td>Liposomes</td>
<td>Diagnostics, imaging, tissue engineering and delivering drugs to specific organelles</td>
</tr>
<tr>
<td>Microparticles</td>
<td>Drug delivery, tissue engineering, and drug targeting</td>
</tr>
<tr>
<td>Gold nanoparticles</td>
<td>Antioxidant, anti-inflammatory, and anti-bacterial agents</td>
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Figure 1 – Common uses of nanoparticles and their applications in various dental fields.

Nanoparticles relevant to the dental field are usually classified as inorganic and organic particles which have diverse properties in relation to security, therapeutic efficacy, toxicity, cost and size. Most common types of nanoparticles used in dentistry include: polymer nanoparticles (such as PLGA or PEG) and lipid-based (such as liposomes).

Figure 2: Immunofluorescence: (A) magnification X20; (B) magnification X40; (C) 3D representation; (D) Nanoparticles found outside cellular membrane. Nuclei are shown in blue after DAPI staining and nanoparticles are shown in green being labeled with FITC.

Personal Research

Uptake of polymeric nanoparticles by oral epithelial cells

Oral epithelial cells were exposed to poly(lactic-co-glycolic acid) nanoparticles at different concentrations and time points. Results show that the maximum cell uptake after 24 hours of incubation with 5µg/ml of PLGA nanoparticles.

Education and Training in Nanomedicine for Future Dentists

Latest advances in nanomedicine will have a profound impact on future dental practice. Several key concepts related to the field should be incorporated into the general dental curriculum:

- A “basic training module” that includes terminology, basic scientific principles of nanoparticle behavior, nanoparticle applications in fields such as diagnostics, imaging, tissue engineering and clinical applications (e.g., anti-bacterial, anti-inflammatory, and anti-cancer therapies).
- A didactic block on biomarkers and nanomaterials and oral tissues.
- A didactic block on methods and techniques of drug nano-delivery.
- A block on ethical issues related to nanomedicine.
- A didactic block on integration of basic science research into dental clinical sciences.

Conclusion

It is important to note that contemporary dental training has to continually adapt in order to prepare students to practice dentistry in the 21st century. In this light, one important step will be to incorporate to date nanomedicine principles into future dental curricula.
KNOWLEDGE OF BIOSTATISTICS IN A GROUP OF DENTAL POSTGRADUATE STUDENTS

Biostatistics & EBD are important in writing and understanding research but their knowledge in postgrad students could be low.

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AIM:
Biostatistics is becoming an integral part of dental sciences because of evidence based dentistry. Awareness regarding the subject is not being sufficiently enough assessed in the field of dentistry. This study was conducted to improve knowledge, attitude, and perception toward biostatistics at academic dental institutions. Therefore, the purpose of this study was to determine the level of knowledge in biostatistics of dental postgraduate students.

Methods:
A questionnaire prepared consisting of 15 questions concerning to the knowledge about biostatistics of 136 dental postgraduate students (94 female, 40 male) from one public and two private Dental Schools in Istanbul, Turkey. The sample was selected on gender, age, department, academic position, and career focus. The frequency distributions of demographic characteristics were examined, the percentages of participants strongly agreed with each attitudinal statement were calculated, and the percentages of participants who felt highly confident for each statement were determined.

Results:

Survey Responses of Dentists towards Biostatistics

Survey Responses of Dentists towards Biostatistics

Percentages of Correct Answers for the knowledge questions

Data entry Interpretation p value planning a survey graphical methods measure of central tendency measure of dispersion

Conclusion
Postgraduate student reported that a low level of confidence and negative attitude toward biostatistics related especially to their level of training in biostatistics. Biostatistics knowledge may have some important positive outcomes in academic life such as designing and conducting correctly research, writing articles and understanding biostatistics may have also some important implications in modulating clinical practice.
Q4 - Please tell us why you chose to participate in this workshop?

• Strongly believe that Evidence Based Dentistry should become a standard in all the faculties.

• Discussion of issues in bioscience, particularly the newer biosciences and technology and their role in the dental curriculum.
Q29 - Research Technology: select the two most important for your institution
LITERATURE REVIEW

2003: completion of the human genome

“Personalized medicine” and “Precision medicine”

Combining unique comprehensive data
– genetic, genomic, clinical and environmental –
about a person to make treatment and prevention as individualized as the condition being considered

Dalessandri D, Zotti R, Bindi M, Bonetti S, Visconti L.
TOPICS

- Genomics/Proteomics
- Stem cells
- Tele-monitoring systems
- Open-platform systems for fabricating customized materials and devices
- E-infrastructure tools facilitating clinical research through data sharing
- Development of devices to deliver drugs to targeted sites around the tooth (Periodontics)
TOPICS

• Salivaomics
• Microbiome and Oral Health
• Bioprinting and Microscale technologies for regenerative dentistry
• Nanofabrication methods for tooth tissue engineering
• Nanoengineered biomaterials for tissue repair and regeneration
The Consortium for Orthodontic Advances in Science and Technology (COAST) is a collaborative inter-institutional working group whose long-term objective is to foster high-caliber, cutting-edge interactions between clinicians, educators, and researchers that will lead to novel developments pertinent to orthodontics and to enhance the delivery of personalized and precision orthodontic care.
Three-dimensional imaging:

- tissue engineering science for replacement craniofacial structures (scaffolds, stem cells, bone morphogenetic proteins),
- potential pharmacological approaches for enhancing bone biology and orthodontic tooth movement.

Genes and Personalized Orthodontics:

- eruption disorders,
- external apical root reabsorption (EARR) concurrent with orthodontic treatment,
- possible roles of important musculoskeletal and pain genes in the development of specific phenotypes commonly treated with orthodontics.
No strong correlations between a single laboratory property and cluster of properties with either short-term (2–5 years) or long-term (10–20 years) clinical performance of restorative materials (both filling materials and bonding systems).
<table>
<thead>
<tr>
<th>Poor correlations</th>
<th>Good correlations</th>
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<tbody>
<tr>
<td>Microleakage</td>
<td>Composite wear</td>
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<tr>
<td>Dental caries</td>
<td>Bonding system durability</td>
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<tr>
<td>Preventive effects of fluoride release</td>
<td>Gap-free margins</td>
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<tr>
<td>Mechanical properties</td>
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<td>Bond strengths</td>
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<td>Solubility and disintegration</td>
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<tr>
<td>Color and color matching</td>
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Materials should be tested in the same way that they would be commonly used in dental practice.
SCIENTIFIC INNOVATION TRANSFER PROCESS

LITERATURE REVIEW

Dalessandro D, Bindi M, Zotti R, Sangalli L, Lafranchi L.
The translational gap ranges from 10 to 20 years for research findings to be incorporated by general practitioners.

Some of the reasons are:

- most research is conducted in highly controlled environments, such as academic settings, and represents only a small percentage of what actually occurs in practice,

- the lack of knowledge transfer of the safety, efficacy, and effectiveness of an intervention to practitioners,

- absence of a formal process for the adoption of new technologies, that is currently dependent on dissemination through dental meetings, continued education programs, and testimonials.
The **effectiveness** of new knowledge (innovation) transfer is influenced by:

**External factors**
- Culture of the practice
- Personal inclination to adopt change
- Perceived relevance of the existing research to their clinical practice
- Financial viability

**Internal factors**
- Type of knowledge on offer
Academic detailing, also known as educational outreach, is a method to disseminate new knowledge in medicine and dentistry for the improvement of patient care.

A trained “detailer” meets face-to-face with a practitioner in the practitioner’s office and provides evidence-based information about patient care topics.

Academic detailing involves the distribution of authoritative and unbiased information sponsored by a credible non-profit institution, such as a university or medical society.
This pilot program, involving faculty, alumni and students, was designed:
• to reinforce the school’s evidence-based practice teaching program,
• to facilitate the flow of information from the scientific literature to dental practitioners,
• to obtain the opinion of experienced practitioners about the practicality of new interventions in real-world settings.

An unexpected result of the program was that students returned from their experiences in the dental offices with an appreciation for the need to keep up with the current literature.
Practice Based Research Network (PBRN)

A collaboration between an academic health science center(s) and community practitioners conducting primarily clinical studies of mutual interest to benefit/enhance patient care, delivery, system assessment, quality assurance, and other factors affecting health care policy.

Most clinical studies conducted in a PBRN would evaluate treatments that are standard of care, and would assess best clinical outcomes in a real world setting.
The PBRN study concept is the antithesis of the traditional controlled study, requiring practitioner expertise as well as selection of patients and, most importantly, treatment by a specifically controlled protocol.

Most clinical studies conducted in a PBRN would evaluate treatments that are standard of care, and would assess best clinical outcomes in a real world setting.

A limiting factor for most PBRNs because they collect data from practitioner offices without the assurance of an audit trail for data integrity.
20-POINTS CHECKLIST FOR SELECTING AND INTEGRATING AN INNOVATION

• How do you know about it?
  • Word of mouth
  • Traditional media (scientific journals, flyers, newsletters, e-mail)
  • Newly conceived information media as Facebook, Instagram, LinkedIn etc. (social media are usually profiled according to user interests)
  • Sales agent
  • Congresses
• How long has it been used?
  • Less than 1 year
  • Between 1 and 3 years
  • More than 3 years

• Are there published scientific papers?
  • No
  • Yes, in a general journal
  • Yes, in an indexed scientific journal
• Is the concept really new? Is it true? Is it important?  
(Critical thinking)

• Who wrote the paper? Which is the company?  
  • Well known researcher/company  
  • Unknown author/company

• Do you personally know colleagues that are using the product?
• What are the results that have been obtained? Are they documented?

• Does the product or method require specific competences to be used correctly? Is it user friendly? (you should evaluate how much the result is operator-dependent)

• Are there alternatives? Why would you choose the new product?

• Does it allow you to do something you were not able to do before?
• Does it allow you to do better what you already do?

• Does it allow you to save time?

• Does it allow you to save money?

• Does it allow you to improve your image?

• Is the product price proportional based on the expected results?
• Will it be cost-effective? what is ROI (return on investment)?

• Will it last and still provide cost-effective service years from now?

• Can it be integrated smoothly with legacy technologies?

• Can it be implemented easily?

• Will it open new revenue sources?
CONCLUSIONS

SECRETS (?) OF SUCCESSFUL INNOVATION

What is an innovation?

Any thing or idea that is new to the individual

Any piece of research that suggests we do something differently in our clinical practice

When we change the way we interact with our patients so that we blend our research knowledge with their values

Why do we need to innovate?

To improve dentistry

and

promote better treatment for our patients
Who has to teach students the skills to question clinical decisions, to search for evidence, to appraise it, to implement it and to evaluate it?
How we can do it?

• Critical thinking
• Problem Based Learning (PBL)
• Intentional learning
  • Reflection
  • Motivation
  • …

WORKSHOP INSTRUCTIONS

Please... be fool!

because

...PEOPLE WHO ARE CRAZY ENOUGH TO THINK THAT THEY CAN CHANGE THE WORLD, ARE THE ONES WHO DO”

Happy Innovating... and Educating!

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