

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

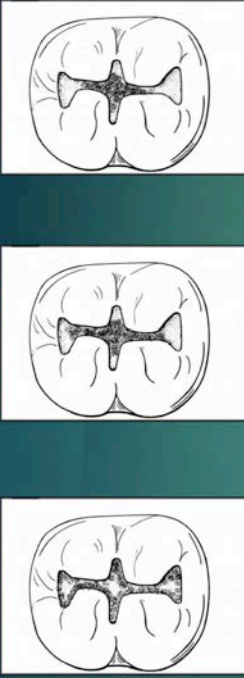
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Moving Forward from 3D to 4D Printing in Dentistry



Introduction: The major concept of 4D printing is self-folding under thermal and humidity changes. This concept relies on understanding how the microstructures of 3D-printed models can undergo spontaneous shape transformation under thermal and moisture changes. The transformation mechanism could be achieved by mixing, in a controllable pattern, a number of materials within the printed model, each with known strain/shrinkage properties.

Methods: 4D printing has a strong potential to be applied in dentistry as the technology could produce dynamic and adaptable materials to be used as functional objects in the oral environment under the continuously changing thermal and humidity conditions. The motion criteria could override the undesired dimensional changes, thermal instability, polymerization shrinkage and microleakage.

Results: 4D printing could produce restorative materials being self-adjusted spontaneously without further intervention from the dentist or patient; that is, the materials could be capable of fixing its failed portions, compensating for some lost tooth structure, while avoiding microleakage or overhangs at the margins. In prosthetic dentistry, 4D printing could provide an option to manage the influence of bone and soft tissue imbalance during mastication (and at rest) with high predictability of the type/direction of forces. It can also produce materials with better fitting and retention characteristics than conventional or 3D-printed materials. Nevertheless, it is important to highlight that 4D-printed objects, having dynamic properties, could provide some cushion as they undergo self-folding compensating for any thermal changes or mechanical forces such as traumatic forces.

Discussion: 4D Printing; in dentistry could have a variety of applications; in restorative dentistry, orthodontics, prosthodontics and implantology.

NANOMEDICINE IN DENTISTRY: SCIENCE AND EDUCATION

Nanoparticles are a scientific discovery that could be applied in various dental fields and should be integrated in dental curricula

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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, cancer therapy or sustained delivery of drugs. Nanocarriers are generally safe, easy to administer, 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 carries, dental surgery, dental materials, dental implants or periodontology. Nano-materials designed in the form of scaffolds, films, membranes, microparticles or nanoparticles are used in a multitude of ways from developing screws for bone fixation to treating periodontal diseases, direct pulp-capping procedures, producing artificial oral mucosa or being incorporated in dental materials.

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 programmes to insure that students, future dentists and patients are aware of the impact that nanomedicine has on the dental field.

Nanoparticles uses in Dental Sciences

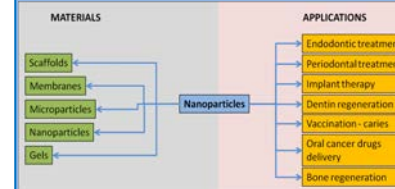


Figure 1 – Common uses of nanoparticles and their applications in various dental fields

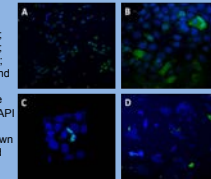
Nanoparticles relevant to the dental field are usually classified as inorganic and organic particles which gives them various properties in relation to toxicity, therapeutic delivery, imaging, cost or size. Most common types of nanoparticles used in dentistry include: gold nanoparticles, polymeric nanoparticles (such as PLGA or PE(G)) and lipid based (such as liposomes)

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

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;



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 disciplines (oral surgery, periodontics, endodontics, prosthetics).
- Interaction between nanoparticles and nanomaterials and oral tissues.
- Methods and techniques of drug nano-delivery
- Nanomaterials based assays used for clinical diagnostics
- Ethical issues related to nanomedicine
- 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 conclusion one important step will be to incorporate to date nanomedicine principles into future dental curriculum.

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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Knowledge of Biostatistics in a group of Dental Postgraduate Students

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AIM: Biostatistics is becoming an integral part of dental sciences because of evidence based dentistry. Awareness of biostatistics is not being sufficiently enough assessed in the field of dentistry. This study was conducted to determine dental professionals' knowledge, attitude, and perception toward biostatistics at academic dental institutions. The objective 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. Demographic data were collected 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: Distribution of Survey Respondents

Demographic	Number (%) of respondents
Gender	
Male	29.9% (n=40)
Female	70.1% (n=94)
Academic position	
1st year doctorate	19.2% (n=39)
Specialist students	14.0% (n=19)
Department	
Endodontics	25.2% (n=34)
Orthodontics	19.3% (n=26)
Periodontology	14.1% (n=19)
Prosthodontics	12.6% (n=17)
Endodontics	9.6% (n=13)
Oral and maxillofacial surgery,	8.1% (n=11)
Conservative	6.7% (n=9)
Oral diagnosis and radiology	4.4% (n=6)

Survey Responses of Dentists towards Biostatistics

	Biostatistics course	p
*Undergraduate education	91.2% (n=124)	p=0.40
*Postgraduate education	95.2% (n=119)	
*Coursework/ seminar	27.2% (n=34)	

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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
(53.4%)	(47.4%)	(37.9%)	(37.9%)	(35.3%)	(30.8%)

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 academical life such as designing and conducting correctly research, writing articles and understanding biostatistics may have also some important implications in modulating clinical practice.

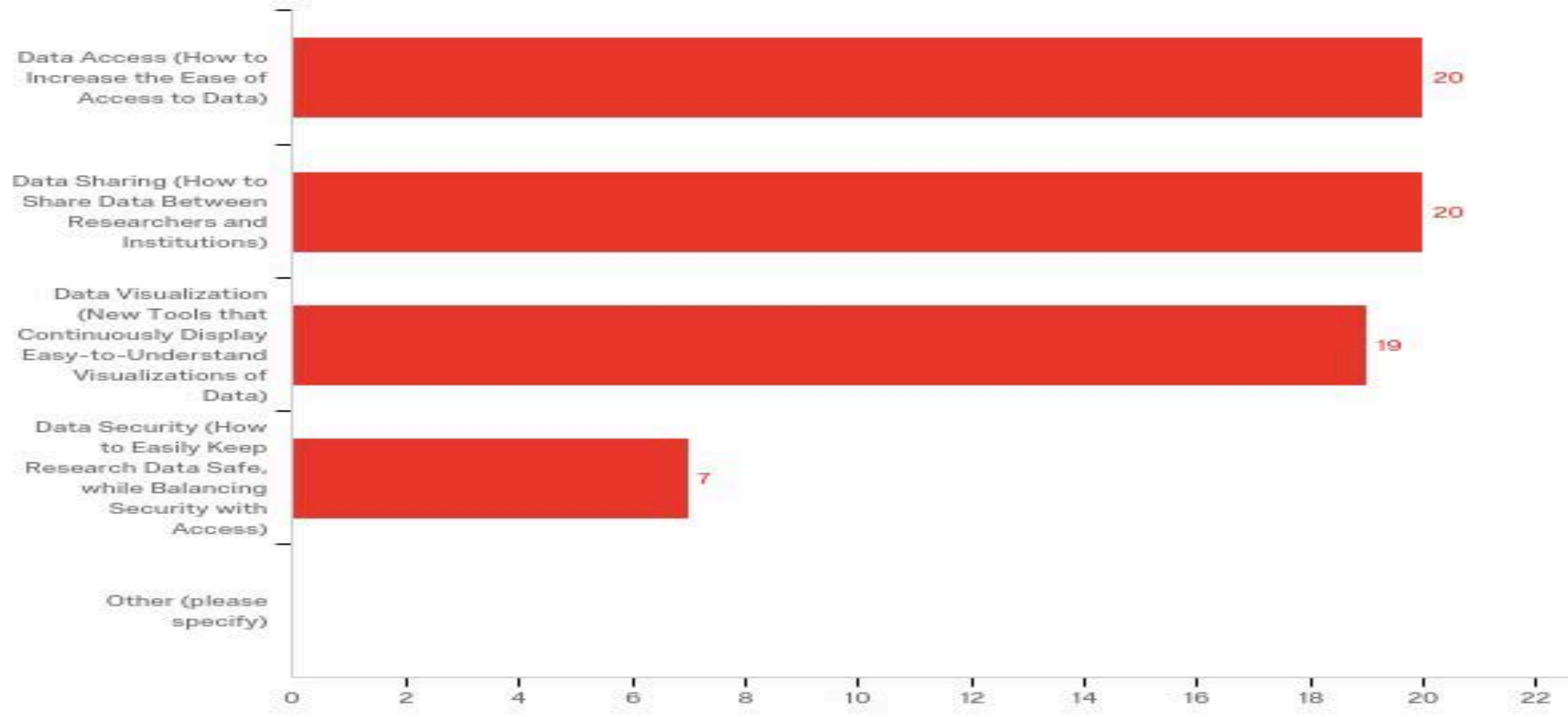
SURVEYS

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





ORIGINAL ARTICLE

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Personalized and precision orthodontic therapy

The Consortium for Orthodontic Advances in Science and Technology (COAST) is a collaborative inter-institutional working group whose longterm 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.



Review

Correlation of clinical performance with 'in vitro tests' of restorative dental materials that use polymer-based matrices

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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).



Poor correlations

Microleakage
Dental caries
Preventive effects of fluoride release
Mechanical properties
Bond strengths
Solubility and disintegration
Color and color matching

Good correlations

Composite wear
Bonding system durability
Gap-free margins

Materials should be tested in the same way that they would be commonly used in dental practice



SCIENTIFIC INNOVATION TRANSFER PROCESS

LITERATURE REVIEW



Dalessandri D, Bindi M, Zotti R, Sangalli L, Lafranchi L.

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

Internal factors

Culture of the practice

Type of knowledge on offer

Personal inclination to adopt change

Perceived relevance of the existing research to their clinical practice

Financial viability



Transferring Evidence-Based Information from Dental School to Practitioners: A Pilot “Academic Detailing” Program Involving Dental Students

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Stephen R. Matteson, D.D.S.

Journal
of Dental
Education

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? It is true? It is important?

(Critical thinking)

- Who wrote the paper? Which is the company?

- Well known researcher/company
- Unknown author/company

- Do you personally know colleagues that hare 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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