Digitalization in dentistry, The Danish Dental Association and Plandent 01.09.2023 - part 2

Speakers
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Reservations
All reservations for the correct reproduction of the course material in the notes are taken by the author.

Top 3 Dental Insights

1. 3D printing and design in general dental practice

Scanning all new patients is the future. By 2023, around 40% of Danish dentists will have an intraoral scanner, but still very few dentists have a 3D printer.

You can print a stent (digital waxup) for a composite filling. For dental traumas, old scans can be used to rebuild teeth. The dental technician prints a model, then you can use injection moulding to rebuild the teeth using a 3D printed digital stent.

It's a good idea to visit your dental lab (and possibly test several dental labs) and get a good working relationship with them so you get it exactly the way you want it.

You can print your models (instead of plaster models) and use your dental technician to design your occlusal splints and crowns, etc. Do you have to design everything yourself? No, you don't. Designing yourself is time-consuming, and the dental lab is very good at it. There are more and more design labs coming up that do digital designs exclusively.

Patients don't really care what their molars look like as long as they are functional and symptom-free. Molar aesthetics is probably more about the dentist's own satisfaction and job satisfaction. It's important to know what makes you happy to work with and then work that way.

Your comfort zone is NOT where the magic happens!

2. VR, AR and robotics in dentistry

Mixed reality:
Real environment
Augmented reality (AR)
Augmented virtual reality (AV)

Virtual reality (VR)

AR is really interesting for us in dentistry, as we can enhance/augment our reality and fx see the xray while you're working. Or fx the dental technician can see what you're seeing via VR.

Cancer treatment planning can be done in VR, so the real surgery will be well timed and planned.

VR, AR and AV can create immersive training with haptic feedback in fx dentistry.

Robot-guided laser surgery:
Robotics can perform automated surgeries with laser. The studies are showing early signs that the laser robot is faster and more precise.

First FDA-approved dental robot for dental implants (Yomi by Neocis). Yomi combines the feel of freehand surgery with the advantages of haptic guidance.

Live surgery will in the future be able to be performed remote. Telemedicine can be used for live surgeries on site with a remote located expert. That way the expert can help many people without having to be physically in the room.

3. AI in dentistry

Many patients are first screened by AI, and then a doctor looks at them afterwards. AI can now see things better and faster than doctors can.

Doctor Google is not the biggest problem anymore, but it is Doctor AI. Insurance companies want to run patient information through AI, which can be problematic.

Individual, personalised chairside dentistry and medicine is the future. We are moving away from serial production towards personalized production.

Gerenative AI can think for us, passive AI can't. AI is not a solitary tool, but it integrated in many different technologies.

AI tool to recognize and classify nerves (CBCT/CT). It's possible to label annotate a nerve fast and chairside on a scan or xray, if you see an interesting case.

Using dentist tagging of xray findings, a machine can perform AI-supported dental assessment via xray can deep learn radiological findings. In the future you can get haptic feedback fx if you begin treating the wrong tooth.

Next year there will be a xray program with full automatic assessment of teeth using AI. It uses tooth segmentation and classification, recognition of pathologies and restorations, and automatic diagnosis and written documentation. It's optimizing time and the lack of dental professionals.

Cephalometric analysis using AI can measure the different anatomical reference points. The AI can show you how sure or unsure it is of its findings.

The best technologies are intuitive and integrate themselves in our lives, in such a way that we can't remember how we ever lived without them before. AI, just like the internet did before, is changing the way healthcare is delivered.

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3D printing in general dental practice

V/ Martin Heiden, dentist

Martin has been working digitally since 2014 and has only used silicone for temporaries. He has tested several different dental laboratories and visited them and has a good working relationship with them, so you get exactly what you want.

Prep borders are okay in the back (molars) if you do a good gingival retraction. But at the front, gingival retraction can affect the aesthetics. Martin not only uses color shade selection from his Trios scanner, but uses it for corpus color, and then takes a Vita color shade with a photo on his smartphone and an app. Anterior teeth get color shade selection with SLR cameras.

Martin prints his models (instead of plaster models) and gets his dental technician to design his occlusal splints and crowns, etc. It's too time-consuming for him to design himself.

Martin has had an intraoral scanner since 2014, has been a beta tester for 3Shape since 2015 and has had a 3D printer since 2021. At Martin's clinic, they are always scanning new patients, so so far they have 16,000+ scans. It's the future.

Martin is the KOL for Dentiq, a chairside printer. Martin will help with the merging of the Trios scan with the Dentiq printer. Right now it's a bit of a hassle and is a barrier for 3D printing.

Martin runs two Danish FB groups: "3D printing for dentists" and "Trio users in Scandinavia"

2023: Approximately 40% of Danish dentists have an intraoral scanner. Only 25 in the FB group have a 3D printer.

You can print a stent (digital waxup) for a composite filling.

For dental traumas, old scans can be used to rebuild teeth. The dental technician prints a model, then you can use injection moulding to rebuild the teeth using a 3D printed digital stent.

It's a good idea to visit your dental lab (and possibly test several dental labs) and get a good working relationship with them so you get it exactly the way you want it.
3D printing process:
Printer (liquid CE-approved resin builds up in layers)->
Wash (of excess liquid resin with alcohol)->
Oven (curing of resin) ->
PC with software and LCD screen (spare part)

3D printer uses AI for the entire process.

Formlabs has a slow-evaporating wash solvent (TPM) for models that don't go in the mouth.

The Ministar press machine works easily.

Other things that can be 3D printed:
Whitening trays (usually what is 3D printed)

Clear retainers (aligners)
Retainer of a smile tooth
Mouth guards

A patient with pronounced erosions and abrasions:
Smile design is a great motivator for the patient.
Elongated teeth can be orthodontically intruded.
Bite down with digital waxup (Munich polycarbonate splints) so the patient can try the 3D model first.

The future:
For example, 3D printed bite rails for bruisers.
A 3D printer costs a one-off investment of 8,5000-14,000 USD.

Benefits of 3D printing:
Faster than making plaster models.
You can print files from technician.
Ready for the next level, better materials.
Deliver to the technician. No more pigs, trimming, dust, plaster traps.

Do you have to design everything yourself? No, you don't. The dental lab is super good at doing that. There are more design labs coming up that do digital-only designs.

Patients don't really care what their molars look like as long as they are functional and symptom-free. Molar aesthetics is probably more about the dentist's own satisfaction and job satisfaction. It's important to know what makes you happy to work with and then work that way.

Your comfort zone is NOT where the magic happens!

Applications of AI in dentistry and medicine - Tendenser inden for digital tandpleje — I dag og i morgen

V/ Jan Wolff, professor, oromaxillofacial surgery, IOOS

AI is going to change our field, faster than we think.

The young generation is very good at learning machine learning, however there are only few young dentists

Jan’s favorite apps:
Google
Medarbejdere AU DK
DeepL Translate
DeepL Write
Google Translate
ChatGPT
GPTZero
Home Feed Research
Brightspace Aarhus

Computer-aided surgery

Industry 4.0:
Autonomous robots
Simulation

System integration
Internet of things
Cybersecurity
Cloud computing
Additive manufacturing (3D printing)
Augmented reality
Big data

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AI precursors:
Additive manufactured medical constructs (AMMCs, 3D printing), material science, bioprinting tissue engineering, VR, AR, robotics.

STL files are used for 3D printing, VR, AR, robotics, AI.

Spectral CT / photon counting will be in the near future.

3D Digital surgery:
Medical image processing —>
3D printing —>
Surgical simulation —>
Digital medical imaging —>
Virtual surgical planning —>
Personalized surgery

3D Workflow:
CT, CBCT, MRI, scan —>
DICOM data and optical scan —>
STL-model and CAD design —>
3D printed skull

Virtual planning and 3D printing:
Plan implant surgery with scan and CBCT —>
CAD in dental lab —>
G-Code for 3D printing—>
Printed drill guide for implant surgery

3D printing reconstruction with materials such as titanium can be used for individual organ implants, fx orbital, jaw or head. Close collaboration between surgeons and engineers/technicians is extremely valuable. They can 3D print a heart!

There's 25 AI tools that work together to 3D print an organ. There's only 5 clicks to order a Tesla car. We have to make AI simpler, for it to become mainstream.

Machine learning need different types of convolutional neural networks in order to train the machine. CBCT: CT slice and many different layers and segmentations.

AI applications in medicine:
Natural language processing (NLP) —>
Clinical decision support —>
Image acquisition and processing —>

Screening / Diagnosis —>
Treatment planning —>
Follow up

Many patients are first screened by AI, and then a doctor looks at them afterwards. AI can now see things better and faster than doctors can.

The use of generative AI for crown designs is being developed by fx 3Shape by “supervised learning”. Karl Hollenbeck is 3Shape Head of AI.

Doctor Google is not the biggest problem anymore, but it is Doctor AI.
Insurance companies want to run patient information through AI, which can be problematic.

AI tool to recognize and classify nerves (CBCT/CT). Label annotation. It’s possible to label annotate a nerve fast and chairside on a scan or xray, if you see an interesting case.

Data labeling supervised learning demands many sets of the same type of patient data sets. You can buy training data sets, and it’s not regulated. You have to annotate where fx the nerves, teeth and implants are using defined boxes and individual numbering, and where there are artifacts on all the data sets, and that way you can train the machine to become smarter. Machine learning has to be trained with both correct and incorrect data sets.

Anyone can do machine learning. Many programs are open source.

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Next year there will be a xray program with full automatic assessment of teeth using AI. It uses tooth segmentation and classification, recognition of pathologies and restorations, and automatic diagnosis and written documentation. It’s optimizing time and the lack of dental professionals.

Cephalometric analysis using AI can measure the different anatomical reference points. The AI can show you how sure or unsure it is of its findings.

Virtual reality will be 3D in 5-10 years, but the social gatherings will still be in real life!

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Live surgery will in the future be able to be performed remote. (See slide)

Automatic surgery planning.

Dentsply Sirona asked a good question: Why do dentists always want a model before the crown? Why not just get the crown immediately?

Cancer treatment planning can be done in VR, so the real surgery will be well timed and planned.

Conjoined twins who shared a brain have been successfully separated by 20 experts using VR planning.

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Change is difficult. Change management is difficult!

Denmark and Finland are very digitally advanced.