Conference on Digitalization of dentistry - part 1
The Danish Dental Association and Plandent 01.09.2023

Speakers
Jan Wolff, Professor, oromaxillofacial surgery, IOOS
Kenneth Vikkelsø Jordy, dentist
Adam Gade Ellesøe, dentist
Morten Rye, dental technician
Allan Stæhr, aesthetic dental technician
Martin Heiden, dentist
Mette Terp Høybye, Professor of Medical Anthropology

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

Top 3 Dental Insights

1. Artificial Intelligence (AI)

We use AI every day for face ID, social media, photo organization, online shopping, banking, Netflix, speech recognition, sending emails, Google search, etc.

Children are exposed to AI as soon as they click on YouTube videos or flip through digital photo albums. Children need to understand AI and how their actions affect future recommendations. We can all, and especially children, be pushed into different agendas if they don't realize it.

Healthcare uses AI for medical diagnosis, drug discovery and predictive analysis of diseases.

The biggest companies are using AI:
Uber has no vehicles.
Facebook/Instagram/Snapchat/Whatsapp/Tiktok has no content.
Alibaba/Amazon/Ebay/Paypal have no inventory.
Airbnb has no real estate.
These are platforms that are heavy on AI algorithms.

The new version of ChatGBT is insane! It works best in English, but also works well in Danish. Jan Wolff advises us all to start using it.

In the future, in a dental practice, you can put all patient records into AI and it will be able to help you with treatment planning and diagnostics, etc.

2. Guided endodontics

Obliterated teeth can be treated in 4 ways:
Observation
Extraction (and implant)
Endodontics
Root tip amputation

- and preferably supplemented with CBCT. CBCT should not be used as a standard, but is a good tool for difficult cases e.g.: non-specific symptoms, inconclusive radiographs, complex anatomy, missed canals during revision or complications (shelves, fractured files, perforations), trauma, obliterated canals, bone changes, etc.

CBCT can reveal if there is, for example, a 15 mm or 21 mm distance to an obliterated root canal. This is very difficult to do with a regular drill, where you're actually drilling blindly.

Obliterated teeth can also be treated with guided endodontics, which is borrowed from guided implant treatment, where the root canal treatment is performed with an individually prefabricated drill guide with a built-in drill path.

Guided endo must always be based on a CBCT!

Obliteration can be done with normal endo, but if the root canal first starts in the middle 1/3 or apical 1/3, guided endo can be performed. If the root canal starts in the apical 1/3, you can also choose to perform a root tip amputation without prior orthograde endo.

It is typically obliterated incisors that can benefit from guided endo with the drill path guide, which can be used to drill down to the obliterated root canal. The drill path must be in a straight line, so occasionally you may have to compromise on aesthetics to get sufficient access to the root canal.

3. Prosthodontics now and in the future
Preparation must have a preparation edge in scanning, and not just a preparation border. Scanning can have some issues with subgingival accuracy. Analog impression material has the advantage of pushing the gingiva aside and pushing some impression material down around the tooth. Otherwise, pocket packing should be used before scanning. Dreyer spoons (triple trays) are difficult to accurately reproduce in the impression unless it is a single molar.

Color shade guides done via scanning should be checked visually or supplemented with a regular clinical shade guide, preferably performed by an experienced dental technician. Shade guides vary depending on the material you are working with. You need to know your material.

Conclusions:
• We shouldn't throw out our analog impression materials just yet.
• Scanning/3D is a great supplement.
• Remember the prep edge and not just the prep border.
• Take a color shade guide yourself or refer to a dental lab.
• The future will be printed!

Current developments and future trends in digital technology

V/ Jan Wolff, Professor, oromaxillofacial surgery, IOOS

Industry 4.0
Autonomous robots
Simulation
System integration
Internet of things
Cybersecurity
Cloud computing
Additive manufacturing (3D printing)
Augmented reality
Big data

Process
Digitization -> Digitalization -> Digital transformation

AI tech for digital transformation
Machine learning
Natural language processing
Computer vision
Robotics process automation

We use AI every day for face ID, social media, photo organization, online shopping, banking, Netflix, speech recognition, email sending, Google search etc.

Children are exposed to AI as soon as they click on Youtube videos or browse photo albums. Children need to understand AI and how their actions affect future recommendations. We all, and especially children, can be pushed into different agendas if they aren't aware of it.

Healthcare use AI for medical diagnosis, drug discovery, and predictive analysis of diseases.

The biggest companies use AI
Uber has no vehicles.
Facebook/Instagram/Snapchat/Whatsapp/Tiktok has no content.
Alibaba/Amazon/Ebay/Paypal has no inventory.
Airbnb has no real estate.
They are platforms that are heavy on AI algorithms.

Time to reach 100K customers
Telephone 75 years.
Web 7 years.
Facebook 4 years.
Instagram 2 years.
PokemonGo 1 month.
ChatGBT 1 week.
The platforms are changing and the biggest ones are democratizing platforms.

Rise of AI is especially due to the rising power of CPU (graphics processing unit) and big data.

AI vs Human
AI: computer science concerned with automation of intelligent behavior.
Human intelligence: we make mistakes, we have feelings, we can't remember and process big data.
AI: has no common sense, can't deal with mixed knowledge, high development costs, can raise legal and ethical concerns.

Soon we will have Artificial General Intelligence (AGI), and after that Artificial Super Intelligence (AGU).

We are moving from passive to generative computing. In the near future the computer will generate new outcomes and ideas for us.

AI is a big compilation of deep learning, machine learning, speech, robotics, neural networks etc. A neural network works the same way as our interconnected brain neurons that form a brain network.

The new version of ChatGBT is insane! It works best in English, but also works well in Danish. Jan Wolff recommends us all to start using it.

In the future in a dental practice you can put all the dental records into AI and it will be able to help you with treatment planning and diagnostics etc.

"Smart medical solution" is using big data and AI. Smartwatches (iWatches) are able to register many health measurements using AI. Fx a doctor can give a patient a smartwatch to monitor them before and after an operation. Microsoft is bringing Python (machine learning language) to Excel. It will be able to have generative AI to help find data patterns in different patients.

Transportation will change into being "mobilization" with self-driving cars and other vehicles. AI can also create art and emulate creativity, but it's an ethical problem to know what is fake and real.

AI engines: ChatGBT, Bard, Bing.

AI can give "hallucination", which is a fake answer with great confidence. Computers can tell us what is correct and not correct. Humans CAN do that.

Whenever we put data into the cloud, somebody's using it for machine learning.

The biggest companies all have CEO's from IVY League Universities, e.g. Stanford, Duke, Princeton, MIT, Harvard, UCLA etc. It's extremely important that we strengthen our universities and student learning.

Guided endodontics
V/ Kenneth Vikkelsø Jordy, dentist

Kenneth receives referrals from many dentists as he only does endo.

Obliteration is caused by:
• Trauma (especially intrusions)
• Dental caries
• Restored teeth
• Orthodontics
• Pulpotomy
• Systemic diseases (e.g. hypercalcaemia, diabetes)
• Medication (e.g. glucocorticoids)

There will be a greater focus on regenerative endodontics in pulpotomy in the future.

Rules on good endodontic access opening:
Law of centrality
Law of symmetry
Law of concentricity
Law of color change
Law of orifice location

Requires good light, magnification, good instruments (drill, ultrasound, endoprobe DG16).

Treatment of obliteration (canal blockage)
Obliteration can be treated in 4 ways:
• Observation
• Extraction (and implant)

- Endodontics
- Root tip amputation

-- and preferably supplemented with CBCT. CBCT should not be used as a standard, but is a good tool for difficult cases e.g:
- Non-specific symptoms
- Inconclusive X-rays
- Complex anatomy
- Missed channels in revision or complications (ledge formation, fractured files, perforations)
- Trauma
- Obliterated pulp canals (canal blockage)
- Bone changes, etc.

CBCT can reveal, for example, a 15 mm or 21 mm distance to an obliterated root canal. This is very difficult to do with a regular blind drill.

Obliterated teeth can heal completely in 81% of cases after 2-4 years by performing root canal amputation with Retroplast without prior orthograde root canal treatment.

Obliterated teeth can also be treated with guided endodontics, which is borrowed from guided implant treatment.

Treatment with guided endodontics
When Kenneth does guided endo, he uses surface scanning with intraoral scanner (STL files) + CBCT (DICOM files) merged in e.g. 3Shapes Implant Studio, SIXATENDO, coDiagnosticX. He plots in that he needs to make a narrow implant, even though he actually needs a guided drill path. Then you get a drill guide with a drill path from Steco, for example, which you can use to drill down to the obliterated root canal. The drill path has to be in a straight line, so sometimes you have to compromise on aesthetics to get sufficient access to the root canal.

It is typically obliterated incisors that can benefit from guided endo. The drill guide is designed with 4-5 windows and several adjacent teeth (preferably including premolars) to stabilize it. If the drill guide tilts, it must be discarded and redone. High stability is very important.

High precision is insanely important for endo. Several studies have shown that guided endo provides high enough precision.

Most dental technicians have good programs such as Implant Studio, so you don't need to have all the programs in the clinic yourself.

Attach the drill guide and open the tooth with a rotary file with Glide and low speeds (2500-3000 rpm). Check the root canal with hand file C+ file #08, which is slightly bent at the tip.

If complications occur with guided endo (e.g. parietal perforation), it may be due to a planning error, inaccurate CBCT and surface scan, inaccurate drill guide fabrication, unstable drill guide tilting during drilling.

Advantages of guided endo:
Minimally invasive, less risk of parietal perforation, shorter time to access opening after planning. Access opening 13:1 guided endo vs free hand.

Disadvantages of guided endo:
Only works on straight ducts, CBCT gives more radiation, requires more visits, can't correct during closure, more expensive for the patient.

Guided endo must always be based on a CBCT! Obliteration can be managed with normal endo, but if the root canal first starts in the middle 1/3 or apical 1/3, guided endo can be performed. If

the root canal starts in the apical 1/3, you can also opt for a root tip amputation without prior orthograde endo.

Guided endo cannot be performed on teeth with loosening or if the root canal cannot be reached in a straight line.

Prosthodontics now and in the future - digital collaboration, opportunities and limitations

V/ Adam Gade Ellesøe, dentist
Morten Rye, dental technician
Allan Stæhr, aesthetic dental technician

Is scanning a replacement or a supplement to conventional impression technique? Are swatches accurate enough with scanners? What happens to the dental technician when they receive a scan? Materials of the future?

Preparation
Scanning preparation should have a preparation edge, not just a preparation border.
Scanning can have some issues with subgingival accuracy. Analog impression material has the advantage of pushing the gingiva away and pushing some impression material down around the tooth. Otherwise, pocket packing should have been used before scanning. Dreyer spoons (triplet trays) are difficult to accurately reproduce in the impression unless it is a single molar. Otherwise, it's best to use a larger impression tray to ensure high enough accuracy.

Color shade guides
Color shade determination with scanners (e.g. Trios, Cerec Omniscan, Cerec Primescan), spectrophotometers and colorimeters have been investigated in several studies, which concluded that scanner-based color shade guides should be checked visually or supplemented with a regular clinical swatch, preferably performed by an experienced dental technician. A shade guide can be difficult if there are many different colors and dental materials in the patient's mouth with MK crowns, light front teeth, dark 3s, etc.

Color shade guides vary depending on the material you are working with. You need to know your material.

The dental technician casts the impression from the bite, cuts it, inserts stabilization pins and then the analog impression is scanned and becomes digital. A digital mockup is made. It's insanely important that the preparation has no sharp edges and has a clear preparation edge. The finished crown is "milled" and cemented.

Materials of the future
E.g. Cerec Tessera and IPS Emax, which are stronger than current Emax crowns.
CAD/CAM ceramics.

Enamel is strong in the same (axial) direction of the enamel crystals, but can be weak across the enamel crystals. Emax is as hard as enamel is in the axial direction.

Institute of Digital Dentistry (iDD).

Emax must be polished to achieve the greatest strength.
Cerec Tessera must be glazed for maximum strength.

Vita is zirconium-reinforced glass ceramic.

"Fracture toughness" is good to know for the crown material.

Sprintray can chairside print 3D crowns (reinforced ceramic resin) and they can print 6 crowns in 15 min. We don't know the fracture toughness of reinforced ceramic resin. We have good printers, but we lack good and strong enough resin materials.

Digital implant workflow requires first and foremost a good scan. They use e.g. Atlantis abutment or Tibase. You can control in the program where you want to place your occlusion on the implant crown.

For example, they use Cercon xt ML multilayer true color technology zirconia crown. The dental technician designs the porcelain crown, corrects the aesthetics and screws the crown on.

Conclusions
• We shouldn't throw out our analog impression materials just yet.
• Scanning/3D is a great supplement.
• Remember the prep edge and not just the prep border.
• Take a color shade guide yourself or refer to a dental lab.
• The future will be printed!