

3-D printing: Next generation of dental modelling

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With 3-D colour scans and colour prints, dentistry has made some significant advancements in digitalization in recent years. At the 2015 International Dental Show (IDS), manufacturer of 3-D printers and production systems Stratasys presented a new system to the dental industry: Objet260 Dental Selection. With this printer, practitioners are able to create models with lifelike textures for precise evaluation and a wide range of shades for customized shade matching. Georg Isbaner, editorial manager of *implants*, spoke with Avi Cohen, Director of Global Dental at Stratasys, about the company's latest development.



Avi Cohen, Director of Global Dental at Stratasys.

Georg Isbaner: Mr Cohen, what is your company's expertise? What is your product offering to customers?

Avi Cohen: In the dental market, in which I essentially established our products over five years ago, we are by far the leading provider of overall solutions. When we initially began serving this industry, we came up with a printer that prints stone models directly from intra-oral scans. At the 2013 IDS, we released the Objet30 OrthoDesk, a small, low-cost desktop printer. For us, every idea is an opportunity to release a new product. We are very much committed to the dental market and release one or two machines every year.

Could you tell us about the product you presented at this year's IDS?

At the 2015 IDS, we presented the Objet260 Dental Selection 3-D printer, which is a new system that enables printing of a full-colour lifelike model—instead of a regular stone model or a one-colour model—from a colour intra-oral scan. The printer brings advanced triple-jetting technology to dental and orthodontic laboratories, allowing 3-D printing of impressively realistic models with a true-to-life look and feel.

You can, for example, print jaw models directly from CBCT scan data, with high-definition tooth, root and nerve canal anatomy rendered in contrasting materials and colours. Holding the printed model in your hands, you can feel and touch the surface, the smoothness and the resolution. Everything from the CBCT scan data is presented here. So when designing a denture for which implants are to be placed, you know exactly where the nerve is and how to avoid it.

In addition to that, when scanning a patient's mouth, you have the option to do this in colour be-

cause the new standard in scanning is colour, and the standard in printing models from the scans will be colour as well, with the ability to print hundreds different colour shades and properties. With our printer, you can also create models with different levels of smoothness, so that, for example, a model of the gingiva is as soft and of the same colour as it is naturally.

For which stage of treatment does the dentist need such a colour model?

With our device, there are 90 different selection possibilities and 11 options for a printed model, so imagine how many you could print. If, for example, you touch your jaw model at the teeth, it is very hard; if you touch it at the gingiva, it is very soft. Using a mixture of soft and other materials enables us to print the real softness of the gingiva.

Now let us talk about the practical usage. You are doing an implant model and you need to determine the emergence profile of the crown that sits on an implant screw. This requires a gingival mask. Today, this is done manually. Everything is digital, but the gingival mask is still manual. With our technology, you can print the gingiva, select the colour and Shore A value, and test how the crown emerges from the rubber and thus the gingiva. We lend realism with materials, properties, textures. This is the only machine in the market that can do this.

Do you think that 3-D printing is an advantage for dentist-patient communication?

Absolutely. Imagine that when the dentist scans the patient's oral cavity he obtains a full model of what the patient's mouth looks like, every broken tooth and every problem, allowing diagnosis and identification of the treatment required. With this, the dentist can explain how he or she is going to treat the teeth. You see this tooth is broken, that one has moved. The model offers a full understanding of what the patient's mouth looks like and it does not look like a stone model; it looks like the patient's own mouth, in realistic colour. So, it is like the patient looking at himself or herself. With this, the dentist involves the patient in understanding what the dental process will be.

How long does it take from capturing the oral scan to receiving the 3-D model?

We print at a speed of about 1 cm in height per hour. In printing, the size is less relevant than the height. You can print 1 cm of enamel in 1 hour or even 2 cm in the same time. Relatively, this is considered to be very fast.

I presume you can also slow down or speed up the printing process in respect of the quality you want to achieve?

Correct.

This concept is the missing link in high-end dentistry and implantology. Where do you see this going in the future? At the moment, we are still talking about models only.

This is the million-dollar question. We have the ability to print real-life models, dentures, crowns, bridges—everything that you see in the human organs. Now, what is the next step? I am not talking specifically about Stratasys or about dentistry. The next step is that you are going to be able to print any end-user part. It could be anything. This is just to show you what a significant advancement we have achieved. Issues from here onwards are materials, properties, medical approvals, and US Food and Drug Administration approvals. But this shows the direction that the market is going in. It could take one year, two years, five or ten.

The dental industry has existed for many hundreds of years already, and now take a look around: in only a few years, we have developed scanning in colour and printing in colour. What comes next? Use this as an end-product in colour. With our technology, not only can you print in colour, but you can also print every pixel of a tooth in a different colour tint. If, for example, you have a missing tooth, I could make you one with every pixel of it the same as one in your mouth. That is really the future that lies ahead for the industry. The day will come, maybe in three, five or even ten years, when everything that is needed in the dental industry can be printed and put in—it is around the corner.



Fig. 2 The new Objet260 Dental Selection.



Fig. 3 Printed jaw model with high-definition tooth, root and nerve canal anatomy rendered in contrasting materials and colours.

3-D printing takes the efficiencies of digital design to the production stage. By combining oral scanning, CAD/CAM design and 3-D printing, dental laboratories can accurately and rapidly produce crowns, bridges, stone models and a range of orthodontic appliances. With a 3-D printer doing the hard work, dental laboratories eliminate the bottleneck of manual modelling and help the business grow. For those eager for the day when everything from scheduling to finished restorations can be achieved digitally and automatically, the future is here.

Fig. 4 Avi Cohen in the interview.



And it could probably enhance quality for people who cannot afford or do not have access to this kind of treatment.

Correct! Those are my thoughts exactly. Let us take, for example, the production of a digital denture. A printed full denture would be so cheap. The digital file is saved, so that instead of €500 it would cost €50. Should you lose your denture, you could just call the dentist, go to his or her practice and your new denture would be ready. It would be similar to glasses: today they are so cheap that you can buy glasses for €5 and change them every day. With dentistry, it will be like this one day. Okay, I broke my denture; I want a new one with even brighter teeth. Have it printed in the dental office and come back in an hour and put it in.

Do you think there might even be a kind of tooth fashion? Maybe wearing a different set of teeth for an evening out?

That is a funny idea. For going to a club, you could have a brilliant set of teeth; for Halloween, you could wear vampire teeth—you could select the type of teeth just as you want. That definitely could be possible.

The wear or the abrasion of prostheses is considered to be a difficult matter. At the moment, implant prostheses are made of very strong and hard material. However, Prof. Daniel Edelhoff, for example, promotes the notion that the crown should wear within a period of four or five years and then be replaced, because he considers it to be more natural and more protective regarding the natural dentition. Do you see an advantage in this respect with printed models?

You can definitely control the softness. You can also control that only the top occlusal area will be soft, and you can control how long it will last, two years or ten. This is, of course, in theory in the future. Also, the price is going to be so much affordable, as we said earlier. You could have different types of dentures at home; for example, if you want to eat peanuts tonight, just put in the appropriate unit; if you want to drink soup, put in the soft one. What I like about the Objet260 Dental Selection 3-D printer is that it creates new possibilities. People come up with ideas that I had never thought of. They approach us with suggestions for printing in new directions that our developers had not even thought of. This is not just a machine; it is a dream machine, a tool. From this, you can go in any direction you want to.

So, it brings engineering directly to the people who really need to work with it?

Correct! It brings engineering and innovation, new ideas and maybe some intellectual properties of what this should look like to dentists and laboratories, definitely.

Thank you very much for the conversation.



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June 12–13, 2015 in Constance, Germany
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FRIDAY, JUNE 12, 2015 (CONGRESS LANGUAGE GERMAN)

➤ SYMPOSIUM SWISS DENTAL SOLUTIONS

- 10.00 – 11.00 a.m. **Dr. Karl Ulrich Volz/Constance (DE)**
New products, concepts and protocols at SDS Swiss Dental Solutions
- 11.00 – 11.30 a.m. **Prof. Dr. Marcel Wainwright/Dusseldorf (DE)**
Intralift and ceramic implants – the perfect symbiosis
- 11.30 – 12.00 a.m. **Dr. Josef Vizkelety/Constance (DE)**
Biological and immunological protocols to boost the immune system and avoid antibiotic treatment
- 12.00 – 12.30 p.m. **Dr. Dominik Nischwitz/Tübingen (DE)**
What is Biological dentistry?
- 12.30 – 1.30 p.m. Break/Visit of the Dental Exhibition

➤ LIVE SURGERIES

- 01.30 – 02.30 p.m. **LIVE SURGERY ①**
Surgical procedure for one-piece Straumann Pure Ceramic Implants
Prof. Dr. Dr. Frank Palm/Constance (DE)
- 02.30 – 03.00 p.m. Break/Visit of the Dental Exhibition
- 03.00 – 04.30 p.m. **LIVE SURGERY ②**
The SCC Short Cut Concept: immediate implantation combined with immediate temporary restoration – made possible by special ceramic thread designs and in consideration of biological and immunological principles
Dr. Karl Ulrich Volz/Constance (DE)



8.00 p.m. **EVENING EVENT** Hotel and restaurant VILLA BARLEBEN AM SEE
BBQ, barbecue specialties and good wine in the beautiful garden of the historic Villa Barleben – open end ... Price per person: 120,- € plus VAT
Registration is mandatory (limited attendance). Please indicate on the registration form.

SATURDAY, JUNE 13, 2015 (CONGRESS LANGUAGE GERMAN/ENGLISH)

- 09.00 – 09.20 a.m. Welcome and opening | Ceramic implants: development, current standard and visions
Dr. Karl Ulrich Volz/Constance (DE)
- 09.20 – 09.50 a.m. **Prof. Dr. John Ionescu/Neukirchen (DE)**
Chronical heavy-metal load at skin and environmental diseases. Diagnosis and therapy
- 09.50 – 10.20 a.m. **Prof. Dr. Vera Stejskal/Stockholm (SE)**
Lecture in English
Allergy and autoimmunity caused by dental metals
- 10.20 – 10.50 a.m. **Prof. Dr. Jose Mendonça-Caridad/Santiago di Compostela (ES)**
Lecture in English
Principles of biological surgery: adult stem cells and ceramic implants
- 10.50 – 11.00 a.m. Discussion
- 11.00 – 11.30 a.m. Break/Visit of the Dental Exhibition
- 11.30 – 12.00 a.m. **Dr. Karl Ulrich Volz/Constance (DE)**
The SCC Short Cut Concept: immediate implantation combined with immediate temporary restoration – made possible by special ceramic thread designs and in consideration of biological and immunological principles
- 12.00 – 12.30 p.m. **Dr. Sammy Noubissi/Silver Spring, MD (US)**
Lecture in English
Pre- and post-restorative clinical implant stability assessment of zirconia ceramic implants submitted to two different methods of surface modification. Results of a clinical 2 year retrospective study
- 12.30 – 12.45 p.m. Discussion
- 12.45 – 13.45 p.m. Break/Visit of the Dental Exhibition
- 13.45 – 14.25 p.m. **Dr. Pascal Eppe/Etalle (BE)**
Lecture in English
Electromagnetic fields and dental metals – the infernal couple
- 14.25 – 14.55 p.m. **Prof. Dr. Marcel Wainwright/Dusseldorf (DE)**
Hyaluronic acid and PRGF – modern tools for biological treatment
- 14.55 – 15.25 p.m. **Dr. Ernst Fuchs Schaller/Bäch (CH)**
Lateral augmentation made easy
- 15.25 – 15.30 p.m. Discussion
- 15.30 – 16.00 p.m. Break/Visit of the Dental Exhibition
- 16.00 – 16.30 p.m. **Dr. Ralf Lüttmann/Eckernförde (DE)**
17 years experience with ceramic implants: one-piece, two-piece – what is important for long-term success?
- 16.30 – 17.00 p.m. **Dr. Oliver Zernial/Kiel (DE)**
MARKETING. SCORNED, LIVED, PLANNED? Is the future white?
- 17.00 – 17.30 p.m. **Dr. Bernd Giesenhagen/Kassel (DE)**
Bone-ring technique and ceramic implants
- 17.30 – 17.45 p.m. Discussion

Congress Fees

Friday, June 12, 2015 > Pre-Congress

Symposium SDS (Lectures)	150,- € plus VAT
Live surgery ① (Straumann)	50,- € plus VAT
Live surgery ② (SDS)	50,- € plus VAT
Live surgery 2 (SDS) is free of charge for participants of the symposium SDS	
Conference charge*	49,- € plus VAT

Saturday, June 13, 2015 > Main Congress

Dentists	250,- € plus VAT
Assistants	125,- € plus VAT
Conference charge*	49,- € plus VAT

ISMI members receive 20% discount on the congress fee on Saturday!

* The Conference Charge is to be paid by each participant and includes coffee breaks, conference drinks and lunch.

Evening event (limited attendance)

Friday, June 12, 2015, Hotel and restaurant VILLA BARLEBEN AM SEE BBQ, barbecue specialties and good wine in the beautiful garden of the historic Villa Barleben – open end...

Price per person 120,- € plus VAT

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Organizer

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