3-D printing at IDS 2017
An introduction to the future

Since the 1990s, when the first non-precious metal bases were produced using 3-D printing methods, the 3-D printing technology has established itself as a modern production process. Today various plastics are also available as high-performance materials. Many users are already considering supplemental extensions and thinking about investing in this technology—the International Dental Show (IDS) in Cologne from 21 to 25 March 2017 will provide an overview.

3-D printing is an additive production process—contrary to subtractive methods, for example computer-controlled milling or grinding ceramics or the machining of non-precious metals or titanium. However, many analogies can be discovered and used as advice when one is considering implementing 3-D printing.

Familiar and established in the dental technology field

First of all, one has to be aware that additive manufacturing is a trusted method. Ordering dental technology items that have been industrially produced using the 3-D printing technique has been common for many years. Among others, one is familiar with selective laser melting, selective laser sintering (SLS), direct metal laser sintering (DMLS) or laser using: Here crowns, bridges and denture bases ("digital model casting bases") are made out of non-precious metal dental alloys. Non-precious metal powder layers are applied and are briefly melted onto the defined places with a laser beam in using a high amount energy. In this way following a construction plan, which was created on the monitor for example using the CAD process, high-precision dental technology items are produced.

Stereolithography is a further, very familiar 3-D printing method. Models, splints and drilling templates can be produced using this method. The principle is similar to laser sintering, however whereas in the latter the applied material is melted on layer by layer, in the case of stereolithography the light polymerisation of plastic is implemented.

In order to be able to assess the 3-D printing method more efficiently in future, it is worth taking a look at the early zirconium oxide technology. Initially large industry machines produced dental technology items and the laboratories were able to order them from external service providers. Later, in-house production also became attractive. In this way, a combination between central manufacturers, cooperative laboratories that carried out contract manufacturing for other
laboratories in order to exploit their own systems to the full and laboratories that offered round-the-clock own production, who also additionally outsourced parts of the production, established itself.

Currently, some laboratories are asking themselves about the optimal implementation of 3-D printing: Drilling templates, different splints, dental technology models, individual impression trays and plastic base casts for the metal cast depict the most frequent indications. Whether they are ordered from an external service provider or produced in one’s own firm, is determined by the amount of the orders to be expected and the speed required by the customer, where own manufacturing principally allows immediate production. IDS 2017 shows which technologies are available and how to invest in them—and thus facilitates an individual economical calculation.

The extended range of printing methods

In addition to the methods already mentioned, among others the so-called multi-jet technology (detailed work up to precisely 16 micron), the fused layer techniques (fused deposition modelling, FDM; fused filament fabrication, FFF) and the mask exposure method prove to be interesting. The multi-jet technology works following the principle of the “ink-jet printer”. For example, (almost) two-dimensional layers of powder are rolled out and then imprinted with bonding agents—exactly on the places where the dental technology item belongs according to the construction plan (= virtual model), the non-bonded power can be simply removed. The material used is either glass or metal powder, whereby with today’s current state of technology only the metal powder is suitable for the production of solid objects, because to this end after the printing process, a sintering and an infiltrating step to fill up existing cavities have to subsequently be carried out. Alternatively, one prints (once again almost) two-dimensional photopolymers according to the construction plan and lets them harden so that the item is formed layer by layer.

Using the layer melting technique one extrudes for example waxes or plastics out of a nozzle or applies the material drop by drop, once it cools down it solidifies—and then the next layer can be applied. Finally, the mask exposure method works similar to the well-known stereolithographical technique. The decisive difference: Instead of using a laser, the plastic is hardened with the aid of a UV LED lamp.
Printing of tooth-coloured table tops and temporaries

One of the big hopes for dental 3-D printing is the optimised colouration of materials, for example of high-performance plastics. The experiences of the subtracting methods have proven that zirconium oxide has initially only been implemented with a veneer covering. More recent versions with a higher translucency are on the other hand used monolithically.

When today complete dentures are produced digitally in a working step in the laboratory and the time-consuming procedure is limited down to two dentist appointment for the patient: why not printed table tops and temporaries soon too? Case studies are already showing now: An implant-supported top jaw complete denture can indeed be made out of PEEK (polyether ether ketone) using the 3-D printing technique and plastic veneers lend it an attractive appearance. PEKK (polyether ether ketone) could also become one of the base materials of the future, especially since in combination with a veneer composite it displays similar characteristics to veneered zirconium oxide.

Digital workflows make 3-D printing additionally attractive

In addition to new materials, the possibility of integration in the digital worlds also provides a boost. For example, the 3-D printing of dental technology models could develop into a frequently used option as a result of the further distribution of intraoral scanners.

"3-D printing offers extraordinary potential," said Dr Martin Rickert, Chairman of the Association of the German Dental Manufacturers e.V. (VDDI) convinced. "This also applies to the closer collaboration between the dentists and the dental technologists, which will be promoted through the joint work in the digital workflows. The backward planning in implantology is an example of this, where 3-D printing creates a concrete additional option in the form of the production of detailed drilling templates at the laboratory. At the International Dental Show in Cologne, the opportunities of this modern production technology can be experienced close-up with tangible innovations and in direct contact to the respective manufacturers."

The International Dental Show takes place in Cologne every two years and is organised by the GFDI Gesellschaft zur Förderung der Dental-Industrie mbH, the commercial enterprise of the Association of German Dental Manufacturers (VDDI). It is staged by the Koelnmesse GmbH, Cologne.