УДК621.79
Ihor Babarykin[1], Oleksii Kapustian[2], Nataliia Zhukova[3]
[1]PhD student, EPh Dpt. NU "Zaporizhzhia Polytechnic"
[2]PhD (Technology), associate professor NU "Zaporizhzhia Polytechnic"
[3]PhD (Philology), associate professor NU "Zaporizhzhia Polytechnic"

APPLICATION OF SELECTIVE LASER SINTERING METHODS IN DENTISTRY

Additive technologies are widely used in medicine, in particular for the production of serial and individual implants from biocompatible metal alloys. 3D metal printing opens up wide possibilities for manufacturing medical products. This technology is successfully used in traumatology, orthopedics, oncology, maxillofacial surgery and veterinary medicine, and is also practically indispensable for individual prosthetics or operations in dentistry.

Selective laser sintering (SLS) technology, which has a wide selection of metal alloys in the form of powder materials, has the greatest prospects for use in dentistry. This technique was developed and put into practice in the middle of 1989 at the University of Texas. The developers of this technology are Carl Deckard and Joe Beeman.

SLS can include multiple techniques, like selective laser melting (SLM) or direct metal laser sintering (DMLS). These all share the same principles but are branded differently for patenting reasons and often vary slightly. SLS is often reserved for the processing of ceramics and nylons, while SLM is mostly for metal alloys.

The name of this technology is self-explanatory: a laser targets loose, powdered material (e.g. metal) which sinters or 'melts' it into the pre-programmed shape. This type of 3D printing is also called powder bed fusion because it uses a bed of powder to support the design and no additional supports are necessary, which keeps the post-processing minimal. This process used to result in a porous and fragile product but this has been improved by using a vacuum and other advancements. Nowadays, the final products

are much denser and stronger and also very accurate (50 - 100 μm). This makes them great for processing metal frameworks such as CoCr or titanium, which are notorious for putting strain on milling machines and burs.

In the process of manufacturing dentures by the method of laser sintering, alloys or compounds with a low melting point are used, such as stainless steel, cobalt-chromium alloys, titanium, aluminium alloys. The SLS process uses a laser beam and a platform that descends with a certain step. The sintering powder is supplied from the feeder and is distributed over the surface of the platform in a thin layer using a special roller. The laser beam first circles the contour of the layer of the future product, and then scans the entire surface inside this contour. As a result, as a result of the thermal effect of laser radiation, the powder particles melt and harden, forming a solid mass of a certain thickness, the shape and dimensions of which correspond to the layer of the 3D model of the prototype product. The generation of the entire product takes place from bottom to top, layer by layer. At the same time, it is constantly immersed in a bath of the initial source powder, which is a supporting support 3D imaging and modelling, and CAD technologies are hugely impacting on all aspects of dentistry.

3D printing makes it possible to accurately make one-off, complex geometrical forms from this digital data, in a variety of materials, locally or in industrial centres. Even now, nearly everything we make for our patients can be made by a 3D printer, but no single technology is sufficient for all our patient's needs.

The technology is already widely used in orthodontics, where high-resolution printing in resin is already an entirely practical proposition, and similar technology is being used to print models for restorative dentistry and patterns for the lost wax process which is becoming increasingly important with the rise of intraoral scanning systems. In maxillofacial and implant surgery, it is becoming commonplace and prerequisite to use anatomical models made by any number of different 3D printing techniques to assist with the planning of complex treatments.

It is widely acknowledged that surgery may be less invasive and more predictable with the use of surgical guides printed in resins (commonly) or autoclavable nylon. For many, the real excitement will be in the direct production of metal-based restorations for implants and teeth, but this is yet to become routine in the dental laboratory in the UK.

Although 3D printers are becoming more affordable, the cost of running, materials, maintenance, and the need for skilled operators must also be carefully considered, as well as the need for post-processing and adherence to strict health and safety protocols. Despite these concerns it is clear that 3D printing will have an increasingly important role to play in dentistry. The congruence of scanning, visualisation, CAD, milling and 3D printing technologies, along with the professions innate curiosity and creativity makes this an exceptionally exciting time to be in dentistry.