

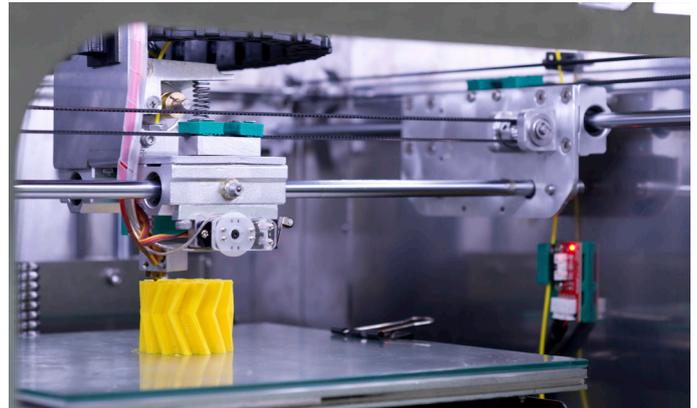
How 3D printing could be shaping our bodies and our futures

The recent guidelines released by the FDA are confirmation of a growing industry which incorporates 3D printing into the world of medicine. It has been a predictable marrying of technology and industry.

The human body is complex and every one is unique – a perfect fit of requirements when you can create detailed, one-off productions of any structure. From our fingerprints to our heart muscles, we present a challenge for imitation which has vexed engineers for decades with only conventional techniques at our disposal.

The issue has always been with matching the solutions nature has developed over millennia of evolution. Orthopaedics is a good example of where we have come close. The internal fabric of a bone is a complex layering of ever smaller structures. It provides good natural strength and a self-regulating system for ensuring the right bone density per individual. In complex fracture repair and complex joint surgery there is a need for bespoke implants which take the place of the natural musculoskeletal tissue. There has been recent success in printing the replacement bone including a bespoke titanium hip implant, seeded with stem cells, implanted into a patient at Southampton General Hospital.

It has been shown through research that it is possible for entire organs to be replicated with a 3D printer.



This would bypass the years of development required to bring artificial organs up to the same standard as orthopaedic implants. To do this, cells must be carefully arranged in an exacting pattern. The major benefit is the possibility of skirting around the organ donation process. Each waiting recipient can have their own new anatomy printed to order. In this world of 3D printed medicine, they could also have custom pharmaceuticals built that work with their unique set of ailments. The entire process from diagnosis to cure can be designed and built to fit them alone.

The most exciting area of 3D printed medicine is how it can partner with imaging technologies. There already exists a natural alignment in the way a CT scanner images in slices, and the 3D printer builds a model in layers. An image can easily translate across to a printer in real time, giving a patient, caregiver or healthcare practitioner a physical model of a previously 2D image. This model could allow young parents to hold their unborn child or give an elderly patient a greater understanding of their joint problems.

Both medical imaging and 3D printing are rapidly advancing independently. New dual CT scanners use two X-ray frequencies to produce a higher contrast image. New 3D printers print faster and more accurately. Others are moving away from 3-axis building to 5-axis, which allows for printing directly onto an irregular surface. As these technologies grow together, we could begin to see surgery which prints organs in-situ. A constant stream of imaging data would allow a 3D printer to adapt and move with the patient to reconstruct missing cartilage or fill a hole in a heart with real heart tissue.

One day we may find ourselves living in the world of sci-fi where missing limbs are reconstructed for us in seconds. Before then we will see improvements in surgeries where previously the only customisation came from the surgeon themselves. We currently have bespoke cranium replacements, the next step is a solution to our organ shortage problem.