# X Ray and CT visible eco coating for 3D printed phantoms

**by**

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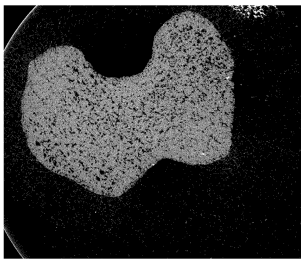
There is a need for 3D printing “bone like” anatomical models with medical grade biocompatible materials, not harmful to living tissue for pre surgical planning. At FibreTuff, Robert Joyce President and Founder has been focused on developing innovative biocompatible thermoplastics with cellulose fiber for (3) printing platforms FDM+SLS+Bio printing. The company is addressing the need by hospitals (POC) to utilize one biocompatible composition for printing functional anatomical models, phantoms, surgical guides and permanent implants. The FibreTuff biocompatible composition has not only been able to print on 3 platforms, but it has a “bone like” feel with good screw retention and cutting ability and osteo conductive properties. These advantages helped in collaborate with FDM printer manufacturers such as Ultimaker in providing a medical grade filament to globally support medical centers, hospitals, physicians to print bone models. For SLS printing anatomical bone models powders are required, where Nylon’s are preferred but have limited functionality. More specifically, the Nylon 12 challenges included limited porosity, challenges to use high speed drills, minimal screw retention, and not have an appearance and feel “ like bone” without radiopacity.



SLS printing with micro CT scanned

Physician’s have explained they greatly prefer a bone model to have a “bone appearance” as a tool for presentation and demonstration to discuss surgery. Hospitals, physicians and instructors also require using existing sterilization methods and radiopacity. Joyce formulated his biocompatible composition to be autoclaved, he also has made the composition without radio pacifiers. He cites where FibreTuff provided a medical grade filament to 3D Lifeprint in the UK for a scoliosis study with a hospital. For bone near/spine the HU’s in real-life can vary between 100-1200HU. Hospital’s will use a marker having 300-400HU. For tissue, depending on the location, can vary between <0-200HU. An off-the-shelf phantom like a “hologic DPA/QDR-1 anthropomorphic spine phantom” encased in Perspex to mimic the tissue to CT Scan. This phantom shows around 300HU for bone. The medical grade filament was printed to mimic a pediatric patient specific scoliotic spine model and showed under CT a 300HU. A tissue mimicking material is as important as the bone like itself for accurate HU values.

Sagittal and coronal scans at 1.5mm x 1mm apart

SLS printed vertebrae made without coating

The printed vertebrae model was then housed in a patient-specific torso shaped model and embedded in a gelatin mix (36g per 800ml water) to replicate the soft tissue. The soft tissue mimicking area showed around 40HU. Per 3D Lifeprint, FibreTuff is the closest 3D printed model to real bone apart from the normal spine phantom (the hospital have been using a holograph ic DPA/QDR-1 anthropomorphic spine Phantom) – June 2019.

In January 2021, a eco friendly coating, having a non toxic barium solution was developed by Joyce for the printable thermoplastic with cellulose fiber composition for SLS printing method. The SLS printing method utilizing Joyces composition offers a “ bone like” porosity in a finished part. A recent x Ray and CT scan of the a printed calcaneus bone with the eco friendly coating had a bone ring of 3000 HU similar to a real bone ring at 2500 HU. The 3D printed CT scan of soft tissue was -250 not exactly at -10 to -50 HU but the discrepancy wasn’t significant per Radiologist. The Radiologist said the pictures was close to real bone and could be used as a phantom. Medical professionals can now utilize their prints for a phantom in SLS and FDM printing methods having bone like porosity.

SLS printed vertebrae made with eco friendly coating