

Advanced materials for 3D Printing to replace cadaver work by Robert Joyce

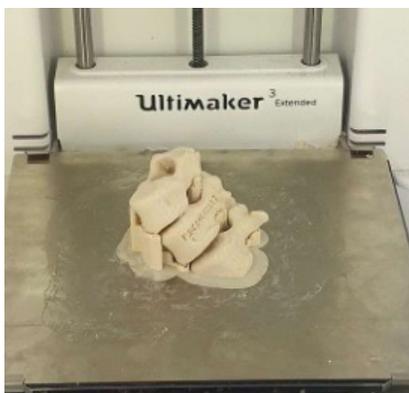
There is an advanced synthetic material for 3D Printing in FFF/FDM to produce anatomical bone models with greatly improved functionality. It is a fact 3D Printed anatomical bone models have utilized materials with limited functionality and consequently limited value. The 3D printing of anatomical bone models to help physicians, radiologists and hospitals consisted of PLA, ABS, Woodfill or Nylon possibly with a barium sulfate if a CT Scan was required. The idea of producing anatomical bone model with cortical and trabecular bone was not practical due to 3D printing material challenges. More specifically, the challenges were strength to weight ratio, radiopacity, good screw retention, drilling and cutting ability. The PLA was too heavy, would not feel like bone, would continue to absorb water and lose properties, minimal screw retention, little or none radiopacity. Woodfill, little radiopacity, heavy when printed with both cortical and trabecular bone, smell and brittle. ABS had challenges of screw retention, strong odors, no radiopacity unless filled with barium sulfate. Nylon doesn't feel and look like bone, has minimal screw retention, and requires barium sulfate for radiopacity.

FibreTuff has been able to meet the challenges with a material having the look and feel of natural bone. Physicians have explained they greatly prefer a bone model to have a "bone appearance" as a tool for presentation and demonstration to discuss surgery. FibreTuff can be 3D Printed with cortical bone at 100% infill and 93% trabecular bone having similar densities of natural bone. FibreTuff has the bone like feel with radiopacity, good screw retention and cutting ability. see vertebrae pictures below from 3D LifePrint. Furthermore, the FibreTuff is hydrophilic, moisture is absorbed into the anatomical model for reducing brittleness, increasing flexibility and impact and providing an improved experience for drilling with specialized instruments.

The 3D printability of FibreTuff has been adjusted for optimization over the years by Joyce. The service center's whom are now printing anatomical bone models have identified FibreTuff as non temperamental with no offensive odors. Joe Rocca for Delray Systems in Rochester MI has been 3D Printing FibreTuff on Ultimakers S5 and 3 for the last 6 months. Delray Systems, FibreTuff and Ultimaker are working together on a project with a surgeon for a cranio maxillofacial demonstrations.

In September 2019, FibreTuff is participating on the Ultimakers Materials Alliance Marketplace, a big commercialization step globally to supply the FibreTuff medical grade filament. Joyce regards Ultimakers Marketplace decision as validation FibreTuff is a superior filament for producing bone like models for their customers in the medical marketplace. He now has shipped the FibreTuff filament worldwide to include Europe, Asia Pacific Region and Americas.

Recent work by 3D Life Print on FibreTuff medical grade filament show an improved CT Scan versus other materials used in printing anatomical bone models. The FibreTuff is the closest 3D printed model to real bone apart from the normal spine phantom (the hospital have been using a hologic DPA/QDR-1 anthropomorphic spine Phantom) – June 2019. Paul Fotheringham Founder 3D LifePrint. 3D Lifeprint utilized an Ultimaker 3 printer to make a vertebrae out of materials identified below in the picture.



Vertebrae 3D Printed by 3D Lifeprints



3D Printed Vertebrae made with FibreTuff on a Ultimaker 3 by 3D Lifeprints and CT scanned