

Used of 3d Printing Technology in Orthopedic Oncology: Custom Surgical Guide and Patient-Matched Prosthesis

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Introduction

Total 11 cases of benign and malignant tumors applying 3D printing assisted surgery which are 6 anatomical models, 11 custom surgical guides, and 4 patient-matched prostheses. Image acquisition was derived from CT scan, 0.5-3 mm slices cut. The contralateral CT scan was used as a prototype for creating the patient-matched prosthesis while the ipsilateral CT scan was used in anatomical model and surgical cutting guide. Anatomical models, used as the preoperative planning tools, were printed by a fused deposition modeling (FDM) printer with acrylonitrile butadiene styrene (ABS) material and a Binder Jetting machine, 3D Systems ZPrinter 650 using Visi Jet PXL materials. 11 custom surgical guides were printed by Envision TEC E-Guide Tint and E-Model. 4 of patient-matched prostheses, which are 2 fingers prostheses, 1 of total constrained proximal interphalangeal (PIP) joint prosthesis, and 1 of navicular 3D custom scaffold, were printed by selective laser-melted (SLM) printer with Ti6Al4V. The pore geometry selective laser-melted Ti6Al4V bone scaffolds was 200 µm, strut size and 500 µm, pore size. Time to produce was 3-20 days. Preoperative planning via anatomical model showed better outcomes in term of decrease operative time and blood loss. Custom surgical guide demonstrated better outcomes comparing to navigation surgery in term of achieving same accuracy but less resection time. According to bone tumors can be found in the unusual locations which there is no off the shelf prosthesis, patient-matched prosthesis has gained popularity and played a major role in this area. An orthopedic oncologist in the United States must complete 4 years of medical school. Following graduation from medical school, the completion of an orthopedic surgical residency (medicine) is required. This residency program is typically 5 years in length and focuses on general orthopedic surgical techniques for common orthopedic injuries. As the residency progresses, the level of injury, disease and trauma treated by the resident becomes increasingly complex. By completion of the residency program, the orthopedic surgeon should be able to competently diagnose and treat a variety of injury and trauma to the bony structures of the body.

At this point, most orthopedic physicians become attending doctors specializing in general orthopedic surgery. However, aspiring orthopedic surgeons who wish to sub-specialize in orthopedic oncology must complete an additional phase to their training known as a fellowship (medicine). A fellowship in orthopedic oncology general lasts an additional one to two years following the completion of the residency

Orthopedic surgery

Orthopedic surgery or orthopedics is the branch of surgery concerned with conditions involving the musculoskeletal system. Orthopedic surgeons use both surgical and nonsurgical means to treat musculoskeletal trauma, spine diseases, sports injuries, degenerative diseases, infections, tumors, and congenital disorders.

Early orthopedics

Many developments in orthopedic surgery have resulted from experiences during wartime. On the battlefields of the middle ages, the injured were treated with bandages soaked in horses' blood, which dried to form a stiff, if unsanitary, splint. Originally, the term orthopedics meant the correcting of musculoskeletal deformities in children. Nicolas Andry, a professor of medicine at the University of Paris, coined the term in the first textbook written on the subject in 1741. He advocated the use of exercise, manipulation, and splinting to treat deformities in children. His book was directed towards parents, and while some topics would be familiar to orthopedists today, it also included 'excessive sweating of the palms' and freckles. Jean-André Venel established the first orthopedic institute in 1780, which was the first hospital dedicated to the treatment of children's skeletal deformities. He developed the club-foot shoe for children born with foot deformities and various methods to treat curvature of the spine. Advances made in surgical technique during the 18th century, such as John Hunter's research on tendon healing and Percival Pott's work on spinal deformity steadily increased the range of new methods available for effective treatment. Antonius Mathijssen, a Dutch military surgeon, invented the plaster of Paris cast in 1851. Until the 1890s, though, orthopedics was still a study limited to the correction of deformity in children. One of the first surgical procedures developed was percutaneous tenotomy. This involved cutting a tendon, originally the Achilles tendon, to help treat deformities alongside bracing and exercises. In the late 1800s and first decades of the 1900s, significant controversy arose about whether orthopedics should include surgical procedures at all.

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