Medical 3-D Printing

How does it works?

CT images are primarily used because they create 3-dimensional images in which anatomy is not superimposed. It takes into consideration the height, length, and width of the anatomy being imaged. After the image is taken, "the 3-dimensional printer takes a 3-dimensional file and digitally converts it into multiple layers (just like axial cuts on a CT scan), depositing material in a 2D area that corresponds to a particular slice. Layer by layer, the 3-dimensional structure forms by stacking the 2D slices which are fused together".[3] The finishing result is almost identical to the anatomy being imaged which what makes this technology so remarkable.

Prosthetic & Implants

- A patient can have a specifically made prosthetic when leaving the hospital because of the capability of computer reconstruction and "on-demand" printing.[9]
- Experiments are being conducted to investigate the reactions humans have to the material used by 3D printing to prevent complications and rejections.[7]
- Materials used can overcome load bearing, pressure, and temperature circumstances among many more goal purposes.[4]
- For more invasive implants patients no longer have to wait years for a suitable donor that are not guaranteed to be a perfect match.[7]
- Printed prosthetics and implants have proven themselves to be Incredibly cheaper.

Surgeries

- "Patient-specific pre-surgical ROI (Region of interest) models can be used to train surgeons in a procedure because multi-material 3-dimensional printed models realistically can emulate the density and touch of skin, fat, bone, and other tissue".[4]
- Studies have proven that the time exposing the patient with ionization radiation is decreased when using surgical guides.[8]
- Fewer errors are likely to occur during surgery with the use of this technology.
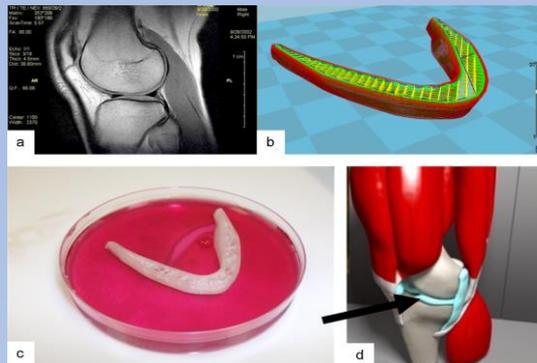- Surgical cases that were not able to be solved without the use of 3-dimensional modeling are now becoming possible.[2]

Figure 1: a. CT image of a knee b. formatting of meniscus c. 3-D printed meniscus[9]

Figure 2: Two 3-D printed models of patients with facial trauma. [6]

Education

- Radiologist's can become the leaders in educating institutions and hospitals. Their presence is useful within all modalities to create excellent patient care and bring their expertise to doctors, medical students and trainees.[5]
- Realistic representation of anatomy and pathology helps students understand the material better.[1]
- Research showed that patients understanding of treatments and diseases improved because models of patient's anatomy were used to help educate.[4]

Conclusion

The radiology department has the opportunity of improving prosthetic implants, surgeries, and medical education by combining diagnostic images with 3-dimensional printing technology. Implants will be cheaper and more attainable. They are more likely to fit the patient and less likely to be rejected. Patients are more likely to be satisfied because of the advancements 3-dimensional printing has to bring to prosthetics. Surgeries will not take as long, risk is prevented, and radiation dose is minimal. Education is progressing and will help patients, students, and healthcare providers.

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