

3D Printing of Fractured Fibula Bone of Human Leg

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Abstract:- 3D printing or Additive Manufacturing or Rapid Prototyping is a way of printing a 3d object or any part of body by the addition of layer top layer immediate from digital model . This technique has that amount of potential that it can produces 3d object in very less time and with the required accuracy . As lot of work is already been done in the field of additive manufacturing and some work is in process so the current progressing field is medical area . 3d Printing has caliber to bring a great change in the advancement of hospitals and their work . Machine receives stl format file from the CAD software or dicom format of files to make prototype of any object in Additive manufacturing . This paper focuses on the various processes involved in printing a bone of leg.

Keywords:- AM : Additive Manufacturing , ABS : Acrylonitrile Butadiene Styrene, BJ : Binder Jetting CAD : Computer Aided Design , CT : Computer Tomography , 3D : 3 Dimensional , FDM : F LOM : Laminated Object Manufacturing used Deposition Modeling, RP : Rapid Prototyping

1. INTRODUCTION

This technology Additive Manufacturing have become ubiquitous in various medical fields . Researchers and Surgeons are using this technology for fabricating of complex implants. More customizable product gave birth to a new technology called additive manufacturing that gives a better satisfaction for users. Additive Manufacturing is also called as 3d printing has been diversely used in many fields . Additive Manufacturing is that type of process in which 3D object is created layer by layer with the help of the material used during the process 3D Printing is that mechanism in which X , Y and Z axes means all three dimensions are well defined which is totally different with that of 2D printing , because 2d printing is a task of producing text or images on paper typically with ink . There are various types of additive manufacturing techniques which has the same basic principle but a little difference in their process of printing a 3d object . Fused Deposition Modeling , Stereo Lithography , Selective Laser Sintering , Electron Beam Melting , LOM and BJ are some examples of additive manufacturing techniques. All have the same purpose of printing the stl files to 3d object . In Medical area , due to advancement of 3D printing there is huge growth . With the help of 3d models of human body

parts there is clear vision for doctors during their surgery because every human being have different data , therefore customization is very necessary . This can only be done with the help of 3d printing technology because only this technology has a potential to do so . Implanting an artificial human body part is one of the biggest advantageous trait of 3d printing . And due to ease in storing and transferring the stl files across the globe made it popular across the world .

2. ANATOMY OF HUMAN LEG BONES

Lower limb of a human body is termed as leg which consists the foot , thigh or even hip or gluteal portion . But a proper human anatomy includes the section of lower limb extended from knee to ankle region . The main purpose of legs are for standing and performing all types of locomotion such as dancing etc. .

2.1 FEMUR

For Femur is also known as the thigh bone of human leg . It is the strongest and longest bone of our body . Due to its strangeness it requires a high force to break so there are rare fractures in this bone . But Motor vehicle collision is one of the main cause for the femur fracture . It can only be fixed with surgery .

2.2 FIBULA

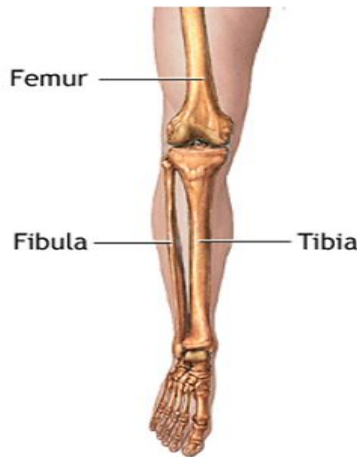
Calf bone is the another name given for fibula bone which is present on the lateral side of tibia bone . It is smaller compared to other two bones . It is below the level of knee joint and extended to ankle joint . There are three types of fibula fracture -

1. Caused by the injury to the ankle joint
2. Part of injury that includes tibia fracture
3. Stress fracture

2.3 TIBIA

An Tibia is a larger bone of our leg . The main work of tibia is to support most of our weight and is very crucial part of knee joint and ankle joint . Motor vehicle collision are the cause for the fracture of tibia .

Leg skeletal anatomy



3. SCANNING TECHNIQUES

- Mechanical Scanning
- X Ray
- Optical Scanning
- CT SCAN
- Laser Scanning
- Ultrasound
- MRI Scan

With any of these technique of scanning we get the dicom format of fibula bone that contains fracture . Our main purpose is to show that fracture area of fibula bone three dimensionally

4. SOFTWARES REQUIRED

1. 4Dicom
2. Osirix
3. Invesalius
4. 3D Slicer
5. Seg3D

5. CONVERSION USING 3D SLICER

1 Loading a dicom file of human leg - To load a dicom file DC M option is available and then from there import the file .

2. After loading a file file go to the volume rendering module and turn on the volume by clicking on its option . After this move towards the display and click the CT bone , so by doing this 3d model of subject is visible on the screen . Then crop the subject as per our requirement .

3. Now go to the crop volume module , click the ROI option and click on apply .

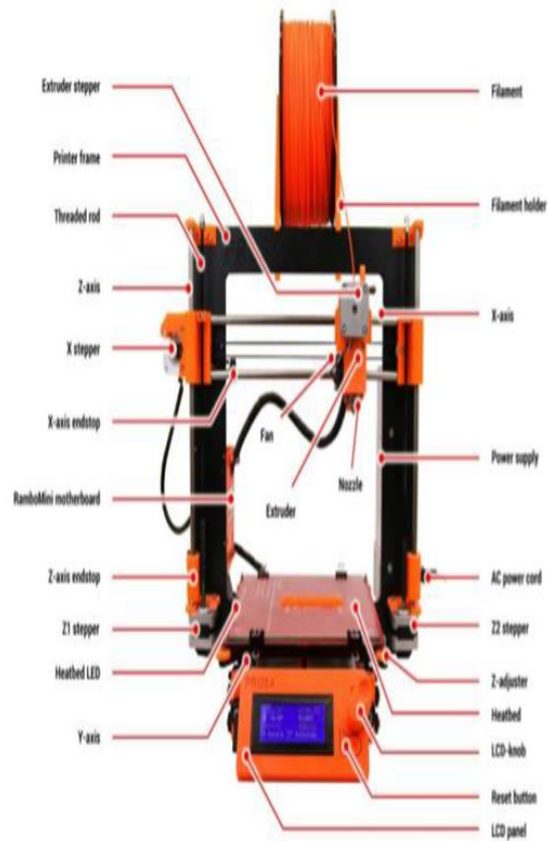
4. Go to the editor model . Edit the model if needed

5. After completing threshold go to model maker and click on apply . The process will take some time .

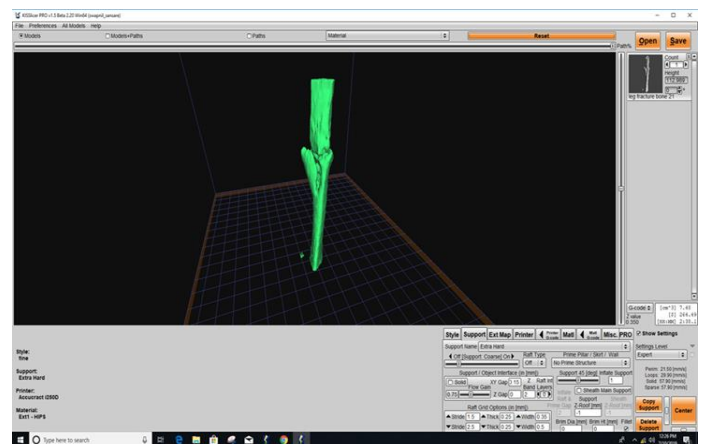
6. After finishing lick on the save option and save it in stl format.

6. PRINTING THE PRODUCT

Now the main task is to make a product and for that we choose any one of the technology of additive manufacturing depending on our requirement . FDM is the most emerging technology in research area so with the help of that FDM machine we make our product. With the help of the picture of FDM it will be able elaborated Cleary with great ease .



After doing slicing and working in software’s like netfeb and kisslicer of FDM machine we get final image of fractured fibula bone just before printing .



7 . FINAL RESULT OF PRODUCT

Material used	ABS
Height of product	112.989mm
Length	89.47mm
Width	89.02mm

8 CONCLUSION AND FUTURE SCOPE

Additive Manufacturing or 3d printing is very good concept in the field of fast growing technology. It has few limitations but still 3d printing has lots of advantages in various fields like in medical and others. With the help of additive manufacturing the , Doctors are able to convert any new idea into reality and saves a lot of time . The 3d printers and new material are in developing conditions so it gives more limpid behavior to this technology or work . Due to additive manufacturing various complexities of manufacturing has been removed. That's why Additive Manufacturing is a most promising technology in future .And in future researchers can do printing of femur and tibia bone of leg containing any disease and it would be for printing some multicolor or multilateral model that could be evaluated . The future work will also include the printing the

similar part with different materials as well as using different techniques for printing

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