PREOPERATIVE PLANNING FOR COMPLEX FRACTURES

USING A DOMESTIC 3D PRINTER (OR WITH MINIMAL RESOURCES)

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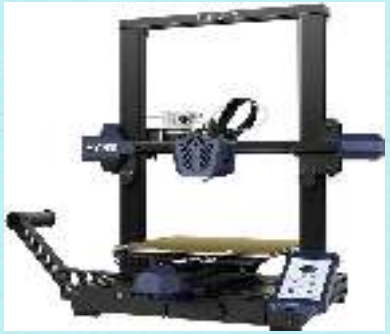
PURPOSE

The technology for preoperative planning and segmentation with the use of proprietary software to print a complex model of a fracture or even the advent of custom 3d Printed materials is available, but not readily and with a very high cost. We present the use of 3d printing thechnology for pre-op planning and for the definitive treatment of patients with complex fractures of the long bones, using a preoperative CT scan and a readily available low cost home 3d printer.

MATERIALS AND METHOD

The CT scans were processed and extracted using **RADIANT DICOM viewer** from the bone window to an STL format. The STL was Sliced using **Ultimaker CURA software**, and the extracted file was sent directly to the 3d printer. The 3d Printer we used was: **ANYCUBIC VYPER** with no conversions and the material was PLA. The total cost of the software (Radiant yearly subscription) and the 3D printer came up to 290 Euros with a consumable cost of 5 euros of printed PLA per fracture.

We present two of the complex cases where we used 3D printing:



- MVA 45 Y.O. Female with a Pilon fracture AO 43-C3 of the left tibia **(img.1)**. The CT we extracted was after the initial ex fix spanning for soft tissue management. On the model **(img.2)** we decided the order of fixation, plate lengths and curvature **(img. 3)**

- MVA 53 Y.O male with distal femoral fracture, tibial plateau and fracture of the femoral neck of the left leg **(img.4)**. In the model **(img. 5)** fragments of value were identified due to the comminution and properly reduced. **(img.6)**

RESULTS

There were no complications from the soft tissues due to the reduced operative time,there was satisfactory reduction and no hardware complications. All fractures healed properly on the postop follow up.

CONCLUSION

The technology is readily available and at a low cost and can be available even in remote areas. Especially in the hands of a novice surgeon it can give confidence for better surgical results. There are publications supporting the analogy of the 3d printed to real bone models.

Major disadvantage in the described workflow can be the user aptitude.However,some more specialized and segmentation software like **MIMICS** can compensate for the STL extraction challenges.

SOURCES

Alemayehu DG, Zhang Z, Tahir E, Gateau D, Zhang DF, Ma X. Preoperative Planning Using 3D Printing Technology in Orthopedic Surgery. Biomed Res Int. 2021 Oct 12;2021:7940242. doi: 10.1155/2021/7940242. PMID: 34676264; PMCID: PMC8526200.