

Case Report: Definitive Treatment With 3D-Printed External Fixator in Severe 18-Year-Old Polytrauma Patient With Posttraumatic Lung Transplantation

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Purpose: An 18-year-old patient was admitted to a university hospital after a severe motorcycle accident. The main injuries were: bleeding from the right pulmonary veins and a pulmonary contusion of both lungs, as well as a femoral shaft fracture. A pneumectomy of the right lung followed immediately at the receiving hospital to stop the pulmonary bleeding, as well as a stabilization of the femoral fracture with an external fixator. Extracorporeal membrane oxygenation was established simultaneously. After this primary therapy, the patient was transferred to our trauma center. In the first attempt of intramedullary nailing, a pulmonary embolism in the remaining lung occurred, thus making further bone surgery attempts an unacceptable risk for this patient. Radiographs and CT scans showed a significant malreduction of the femoral fracture.

Methods: We developed a novel technique to address the malreduction of the femur during the stay in the ICU without further surgery. Using CT data of both lower extremities and open-source software, the fracture was virtually reduced. Aided by computer-assisted design software, an individual external fixator was designed and 3-dimensionally printed. It was placed over the preexisting Schanz screws, thus forcing the fracture fragments into the correct position. The patient could stay in the ICU ward for this procedure. To address the respiratory situation, a rare semi-lung transplantation was performed.

Results: Concerning the femoral situation, postinterventional radiographs and CT scans show good fracture reduction and healing. The patient is able to walk normally after 12 months of rehabilitation. The transplanted lung was well accepted by the host, and lung function is close to normal.

Conclusion: By using open-source software and 3-dimensional (3D) printing technologies, we have been able to create a 3D-printed external fixator for definitive treatment of a femoral shaft fracture, leading to the first successfully treated femoral shaft fracture with the help of a 3D-printed external fixator.