Three-dimensional Printed Models of the Rib Cage in Children with Non-accidental Injury as an Effective Visual-aid Tool

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Three-dimensional (3-D) printing is gaining terrain in medical education, presurgical evaluation and recently as forensic evidence in court. Physicians, including radiologists, often provide expert testimony in court cases involving children with rib fractures and other injuries concerning for child physical abuse. Effectively communicating the complexities of fractures and other skeletal findings to nonmedical personnel using standard radiology studies can be challenging, especially during medical courtroom testimony. For this reason, we printed two 3-D models of the rib cage from the chest computed tomography (CT) scans of two patients with suspected non-accidental injury. The patients also had available chest radiographs. The DICOM (Digital Imaging and Communications in Medicine) data were 3-D reconstructed and segmented using two attenuation thresholds. We removed unwanted structures and printed them on a commercially available scanner. A pediatric radiologist, blinded to clinical data, reviewed both 3-D models, identified all rib lesions and classified them according to their healing stage. We compared the 3-D models and the chest radiograph against the chest CT as the standard of care. We convened a meeting with the Child Protection Team at out institution to get their feedback and opinions about the models. From our observations of our experts, three spontaneous interactions were observed. Instinctively, the experts picked up and grasped the models, rotating them, feeling them and angling them to better visualize the fractures from multiple angles. The experts expressed a willingness to consider using the models in court.

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