Trauma and Emergency Care

Commentary

ISSN: 2398-3345

Virtual anatomy and pathoanatomy: Cinematic rendering of a traumatic brain injury

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Case report

We present a 55-year-old patient suffering a severe traumatic brain injury after falling several meters from an agricultural implement. The patient immediately lost consciousness and was brought to the emergency room. The initial polytrauma computed tomography (CT) (Figure 1) revealed a complex skull fracture, a fracture of the mandible, the zygomatic bone, and some minor lesions of the cervical spine.

Since a big fragment of the skull cap was dislocated into the orbita, the patient was moved to the neurosurgical department immediately. To provide the surgeon with additional pre-operative information, the affected area was visualized using cinematic rendering additionally (Figure 2).

The surgical procedure was performed without any complications. The bone fragments could be reduced successfully without harming any structures of the visual systems. After all the patient could be discharged in good general condition.

Discussion

While post processing techniques like multiplanar reconstructions (MPR), maximum intensity projections (MIP) or volume rendering (VR) are established since decades, cinematic rendering (CR) is a relative new technology [1,2].

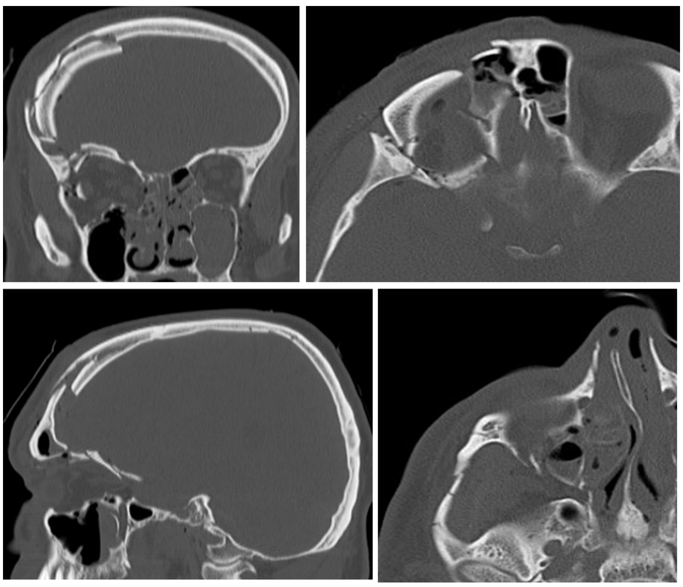

Figure 1. Initial polytrauma CT revealing a complex skull fracture

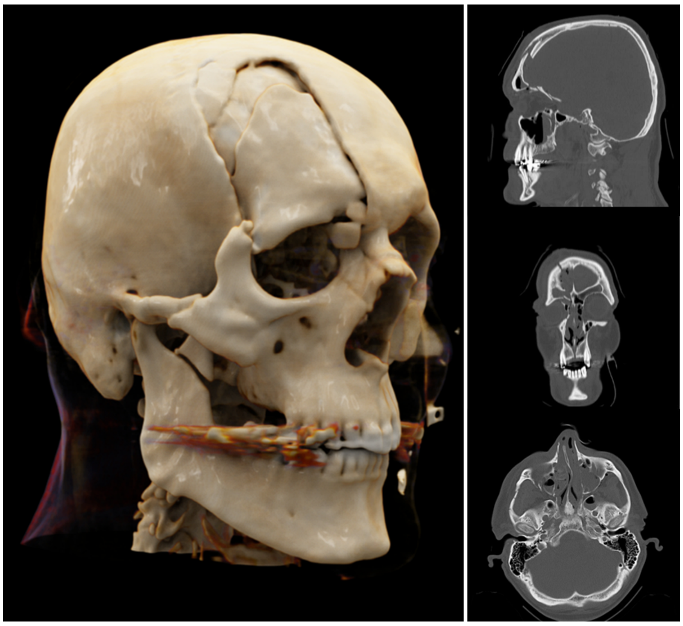

Figure 2. Three-dimensional visualization of the polytrauma CT scan using cinematic rendering

Although VR and CR are sharing the fundamentals, CR is based on an algorithm using path-tracing methods and a global illumination model to create photorealistic 3D images through reproducing the complex real-life physical propagation of light [3] (Figure 3). Herewith the quality of the 3D-visualization is further enhanced by the high contrast of the bone [4]. This realistic way of showing light and shades increases the depth-discrimination for the human visual system and therefore improving the perception of those structures [5].

This case also clearly depicts the advantage of cinematic rendering in potentially enhancing pathology conspicuity (Figure 5) [6]. To get the correct impression of complex facial and/ or skull fractures as in the

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Key words: *virtual anatomy, virtual pathoanatomy, cinematic rendering, computed tomography, traumatic brain injury*

Received: November 18, 2020; **Accepted:** December 14, 2020; **Published:** December 17, 2020

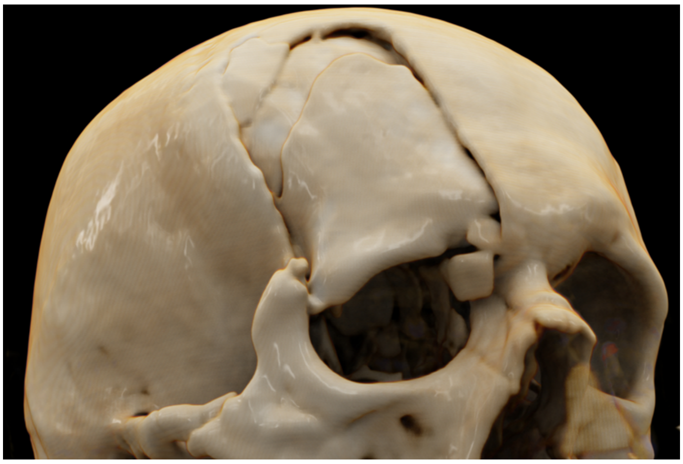

Figure 3. In cinematic rendering, the combination of path-tracing methods and a global illumination model allows a lifelike display of the affected area

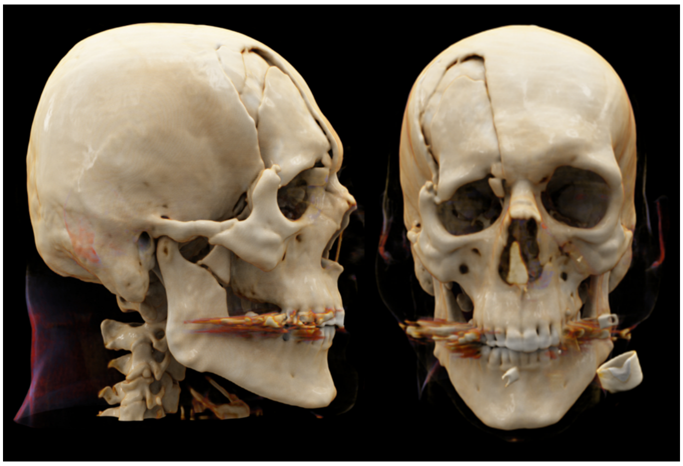

Figure 4. The combination of photorealistic display and a clear depiction of the entire anatomical region increases pathology conspicuity

case above a radiologist needs at least two different plains while a three-dimensional rendering can provide that information in just one or only few pictures (Figure 4) [4,7].

Especially in trauma patients 3D-rendering techniques may offer further information about the fragment size and their relation to the surrounding structures [8]. Furthermore, the usual process of preoperative evaluation often involves the mental integration of multiple images – sometimes acquired from different modalities. By providing all those information with a single modality the time needed is reduced while the quality of the preoperative planning may be increased [9]. These advantages make cinematic rendering 3D visualization valuable for imaging of trauma [10-15], also in the sense of developing new methods of teaching [16-18].

Disclosure

No conflicts of interest. No grants or financial supports.

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