SUPPLEMENTARY MATERIAL 1

CT Scanners, Scanning Parameters, And Details of CT Image Preprocessing

CT studies were volume scans from the beginning of the thorax to the lower edge of the 12th rib and were primarily performed using four scanners (Optima 680, GE Hangwei Medical Systems, Beijing, China; Brilliance 16, Philips Healthcare, Eindhoven, the Netherlands; Ingenuity 128, Philips Healthcare, Cleveland, OH, USA; SOMATOM Definition Flash, Siemens Healthineers, Forchheim, Germany). The reconstructed slice thickness was 1, 2, or 5 mm and the tube voltage was 120 kVp. The tube current was approximately 100–700 mA, depending on the weight of the patient. A bone reconstruction kernel was used. Table 1 shows the different datasets, corresponding CT scanners, and scanning parameters used in the study.

Rib fracture axial images (window position: 500; window width: 1500; 1-mm or 5-mm slice thickness) were downloaded from the picture archiving and communication system and stored as digital imaging and communications in medicine (DICOM) metadata. The DICOM images were then converted to a lossless 1024 x 1024-pixel 24-bit greyscale joint photographic experts group (JPEG) format image using MicroDicom viewer (version: 2.9.2, MocroDicom, Sofia, Bulgaria). Patient information was anonymized before analysis. A rectangular bounding box approximately 0.7–1.5 cm in size was drawn on every CT slices of rib fractures using labelImg (version: 1.8.1, available at https://github.com/tzutalin/labelImg). Theos and putil Python libraries (version: 2.7.15, available at http://www.python.org) renamed all data to convert the data set to the voc2007 format. A record file containing raw image data, tag data (x, y, and z coordinates), and length and width information was then generated using MXNet (version: 1.1.0, available at https://github.com/apache/incubator-mxnet). Next, normalization (all pixel values divided by 255) was performed before the images were used for training. We applied online image augmentation strategies, including horizontal flipping, cropping, and random rotation.

Table 1. CT Scanners and Scanning Parameters of Different Dataset

Dataset	CT Scanners	Slice Thickness (mm)	Tube Voltage (kVp)	Tube Current (mA)	Reconstruction
Training set, validation set 1, control set	Optima 680 (GE)	1	120	Approximately 100–700	Bone
Training set, validation set 2	Brilliance 16 (Philips)	5	120	Approximately 100–700	Bone
Validation set 3, validation set 5	Ingenuity 128 (Philips)	1	120	Approximately 100–700	Bone
Validation set 4, validation set 5	SOMATOM Definition Flash (Siemens)	2	120	Approximately 100–700	Bone