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Appendix: Details of 3-D Mapping Technique

Obtain Computed Tomography (CT) data

The DICOM (Digital Imaging and Communications in Medicine)-formatted CT data of all Hoffa fractures were acquired from the PACS (picture archiving and communication system) workstation.

Mimics Software (version 19.0; Materialise)

(1) Create a new project file for each patient using “New Project Wizard.”
(2) Standardize the axial, sagittal, and coronal slices for measurement using “View→Reslice→Along Plane→Interactive MPR (multiplanar reconstruction)” and then adjust the blue line to make sure the

(a) axial plane: is perpendicular to the posterior cortex of the distal femoral shaft,
(b) sagittal plane: is perpendicular to posterior condylar axis, and
(c) coronal plane: is perpendicular to the sagittal and axial planes.

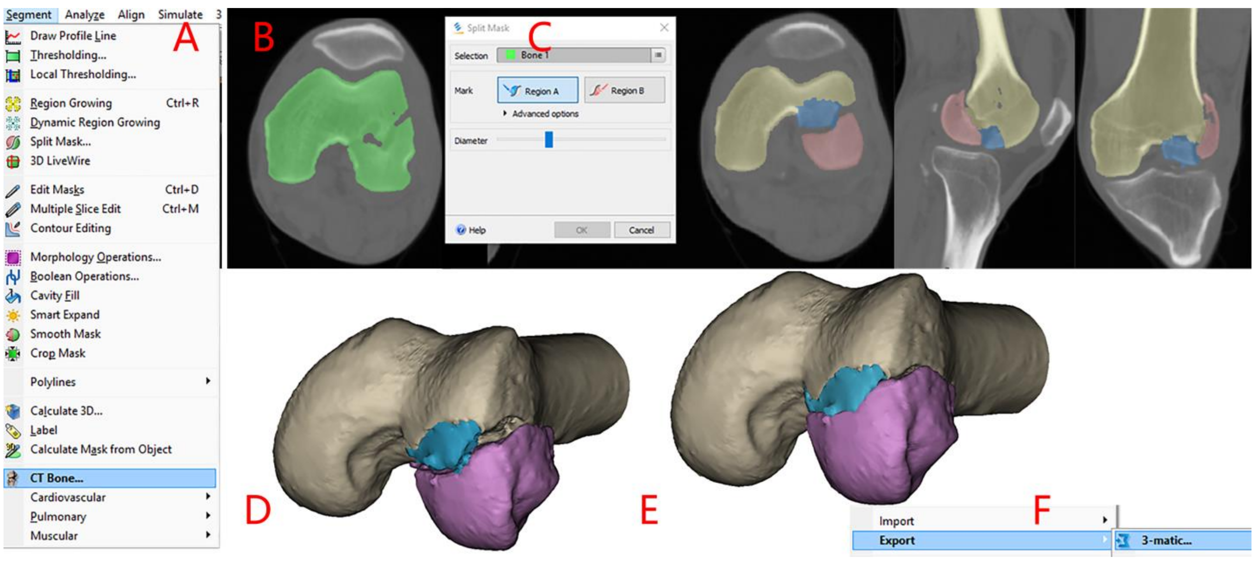
(3) Create a mask to indicate which part to reconstruct by using “CT Bone Segmentation” (Fig. E1-A). At this moment, the mask contains all fragments as a whole (Fig. E1-B).
(4) Before reconstructing the 3-D models, we split the mask that contains all of the fragments into separate masks using “Split Mask” (Fig. E1-C), and then, we can begin to reconstruct the 3-D models of each fragment.
(5) Reconstruct the 3-D models of each fragment using “Calculate 3D by Mask” and choose the optimal quality (Fig. E1-D).
(6) Reduce the fragments to the proximal part using the “Pan” and “Rotate” functions (Fig. E1-E).
(7) Export the reduced 3-D models to the 3-matic software (Fig. E1-F).

3-matic (Materialise)

(1) Adjust the transparency of the prepared template model of the distal aspect of the femur to 50% (Fig. E2-A).
(2) Mark the imported 3-D models of the distal aspect of the femur and each fragment in different colors.
(3) By means of transparency, superimpose the imported 3-D models to fit the standard template of the distal aspect of the femur in a healthy adult using “Align→Scale & Mirror & Interactive Translate & Interactive Rotate” (Fig. E2-B).
(4) Draw every fracture line on the template model by “Curve→Create Curve” (Fig. E2-C). If necessary, trim the fracture line by “Curve→Close Curve & Connect Curve”.
(5) To make sure the path is attached on the surface of the 3-D model between 2 selected dots, check the “Attract curve” in the “Attract and attach options” in the setting of “Create Curve” (Fig. E2-D).
(6) Using the same method to draw the comminution area in another identical template, isolate and keep the comminution area as an independent model and delete the other parts. As a result, the comminution areas of all of the patients are drawn on identical template models; once complete, the superimposition of the semi-transparent models can be used to indicate the distribution and incidence of the comminution.

(7) Now we have obtained the fracture line drawn in the template model and a thin surface model that represents the comminution zone (Fig. E2-E).
(8) Hide the fracture line and the comminution area model in the dendrogram.
(9) Repeat the abovementioned process for all Hoffa fractures, and then “show” all of the fracture lines, marking fracture lines in the medial condyle in cyan and fracture lines in the lateral condyle in red. Mark the comminution zone of each case in black, and adjust the transparency (Fig. E2-F); superimposition of all marked comminution zones will indicate the distribution and incidence of the comminution.
(10) Screenshot/record the distributions of the fracture lines and comminution zones.

Fig. E1



The 3-D reconstruction of Hoffa fracture fragments using Mimics software. (Reproduced with permission of Materialise.) Fig. **E1-A** The menu of “CT bone segmentation”. **Fig. E1-B** The creation of a mask. Fig. **E1-C** Separation of the mask of by means of the “Split Mask” function. **Fig. E1-D** Reconstruction of each fracture fragment. **Fig. E1-E** Virtual reduction of fracture fragments. **Fig. E1-F** “Export” to 3-matic software. Mimics® and 3-matic® software programs are owned by Materialise® © 2017.

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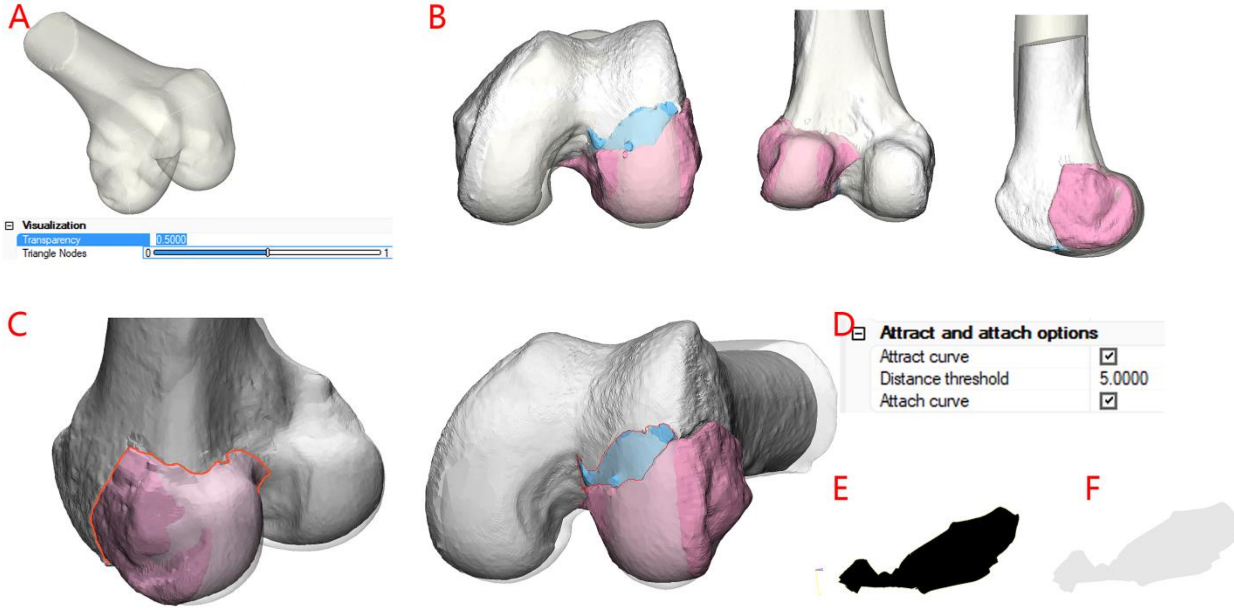
Fig. E2



The mapping of Hoffa fracture lines and comminution zones on a 3-D template using 3-matic software. (Reproduced with permission of Materialise.) **Fig. E2-A** Transparency adjustment of the 3-D model. **Fig. E2-B** Superimposition of the fractured Hoffa model onto the template of the distal aspect of the femur in an adult. **Fig. E2-C** Delineation of the fracture line and comminution zone on the template. **Fig. E2-D** The menu of "Attract and attach options". **Fig. E2-E** The thin surface model representing a comminution zone. **Fig. E2-F** Transparency adjustment of the marked comminution zone. Mimics® and 3-matic® software programs are owned by Materialise® © 2017.