The Role of 3D Reconstruction True Volume Analysis in Osteochondral Lesions of the Talus

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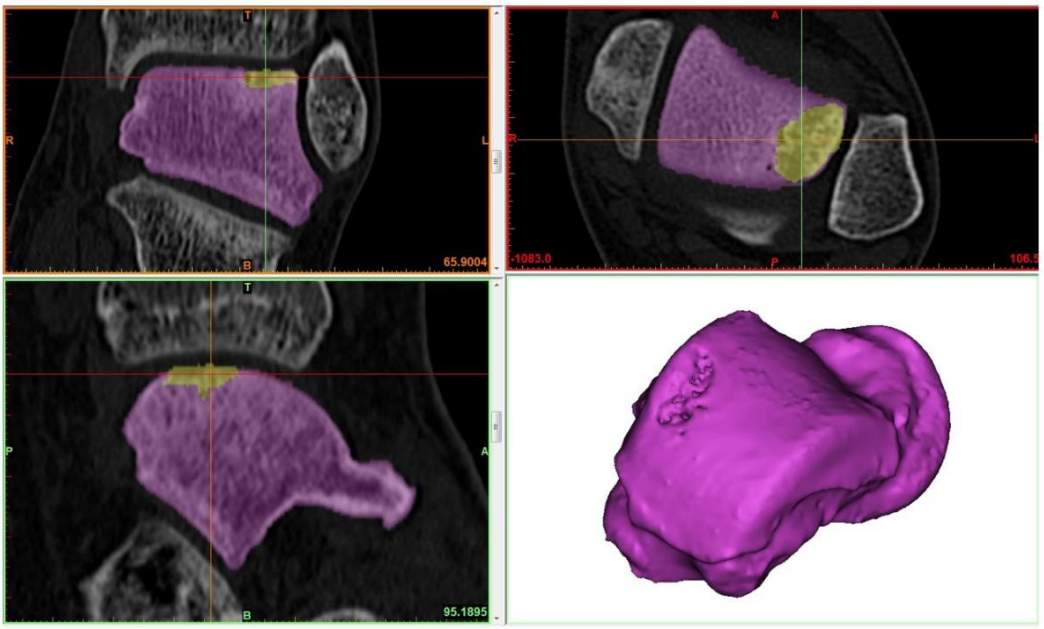
Introduction/Purpose: Evaluation and management of osteochondral lesions of the talus (OLTs) often warrant advanced imaging studies such as CT and/or MRI. While MRI has its advantages in determining the degree of cartilage damage, stability of the fragment and edema, CT imaging is better delineates the osseous anatomy and extent of the lesion. The latter imaging modality offers increasing acuity and resolution in characterizing the complex osteochondral landscape via three-dimensional (3D) reconstructions. It is possible that orthopedic surgeons may overestimate the size and misinterpret the morphology of OLT from conventional MRI and CT thereby influencing treatment strategies. The purpose of this study is to determine the utility of a novel means to estimate the true-volume of OLTs using 3D reconstructed images and volume analysis.

Methods: After IRB approval, an institutional radiology database was queried for patients with OLTs and compatible CT scans between 2011 and 2016. Fourteen patients were found to have OLT compatible with the software used to approximate true-volumes of 3D reconstructed images. 3D reconstructions were created using Mimics software (Materialise, Belgium). From the 14 reconstructed OLTs, 5 were randomly selected for evaluation. 10 orthopedic surgeons independently estimated the volume of these 5 OLTs via standard CT scans. Then 3D reconstructions were made and true-volume (TV) analysis measurements of each OLT were generated. The percent change in volumes from CT were compared to TVs determined from 3D reconstructive analysis.

Results: On average the volume calculated by conventional CT scanner grossly overestimated the actual size of the OLTs. The volume calculated on conventional CT scanner overestimated the size of OLTs compared to the 3D TV reconstructed analysis by 285-864%.

Conclusion: Our results show that conventional measurements of OLTS with CT grossly overestimates the size of the lesion by up to 8-times the actual lesion size. This overestimation of volumes of the lesion can drastically change surgical planning and may lead to unnecessary costs associated with specific surgical treatments. With the use of our newly defined model for volume measurement in OLTs, we can more accurately predict the exact size of the OLT. This can better guide surgeons to choices both the correct cartilage restoring procedure as well as the need for bone grafting.

Figure 1. Illustration of 3D reconstruction taken from CT views (axial, sagittal, & coronal). The OLTs are highlighted yellow.



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