The purpose of this study was to assess the accuracy of medical models, by validating the accuracy of additive manufactured skull models with a coordinate measurement device.

Materials and Methods

A human skull with eight 5mm sphere fiducial markers was measured with a CMM on a custom index. All markers were measured from an origin (the fiducial at the anatomical Sella) and scanned on a MDCT scanner. STL files were developed from the scan and 7 models each were fabricated using a VIPER SLA as a pilot group, then 7 for the 7000 SLA, (resin) and 2 corps printer (gypsum/ binder). Each model was built with the same build set-up along with validation coupons and identification tags. After the appropriate post-cure, each model was measured in the same manner as the Standard. A Euler Angel Rotation to align the coordinate axis of the standard and the model was used to account for discrepancies in model placement for measurement. Data was collected using the absolute difference in the measurements of the Standard to the fabricated model.

Results

The deviation of the models to the standard appear in Table 1. The deviation is measured in the x, y, and z axis. The maximum deviation of the models to the standard is 0.5105 mm.

Discussion

The maximum deviation of the models to the standard is within the acceptable range of the system. These results support the data presented in Table 1. The deviations for the X and Z axis are less than the Y axis.

Conclusions

The results of this study indicate that in a controlled setting, the greatest discrepancies of medical model fabrication correspond to the largest dimension of the orthotopic voxel volume of the MDCT scan, which is related to the slice thickness of the scan and the Z axis of the model. Clinicians should be aware that the traditional imaging protocols for diagnosis that allow for large slice thickness, although they provide less exposure to the patient, may be less desirable for use in surgical manipulation software and accurate rapid prototype models and implants.