Automatic verification of isocenter in stereotactic radiosurgery

A standard portal film-based procedure is commonly used to verify the isocenter position in linac stereotactic radiosurgery. Images of a radiopaque spherical pointer, produced on the same verification film for different gantry positions, are digitized by a high resolution CCD camera. A computer routine was developed in order to recognize the pointer image within the radiation field image. The algorithm is based on the analysis of the gray level histogram and calculates the pointer center position by means of a second order polynomial fit. The radiation field center can also be determined from its penumbra by extracting a circular profile. Pointer misalignment is obtained as the shift between the pointer and the field centers with respect to an orthogonal frame. Our method was compared to the proposed standard, which is based on visual inspection. Several pointer images were taken and the related precision was evaluated. We determined a 0.03 mm accuracy for our method. As the automatic analysis excludes the human error, it was also possible to find the magnitude of the setup reproducibility, which does not depend on the chosen method and was calculated to be 0.15 mm. From the error propagation formula a 0.14 mm reproducibility was obtained for the standard procedure.