Original research article

**Initial evaluation of intrafraction motion using frameless CyberKnife VSI system**

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**Abstract**

**Aim**

To analyze intrafraction movement in patients undergoing frameless robotic radiosurgery and evaluate the influence of image acquisition frequency on global accuracy.

**Background**

Stereotactic radiosurgery requires high spatial accuracy in dose delivery. In conventional radiosurgery, a rigid frame is used to guarantee a correct target alignment and no subsequent movement. Frameless radiosurgery with thermoplastic mask for immobilization cannot completely eliminate intrafraction patient movement. In such cases, it is necessary to evaluate its influence on global treatment accuracy.

**Materials and methods**

We analyzed the intrafraction motion of the first 15 patients undergoing intracranial radiosurgery (39 fractions) with the CyberKnife VSI system at our institution. Patient position was measured at a 15–90-s interval and was used to estimate intrafraction patient movement.

**Results**

With our acquisition image protocol and immobilization device, the 99% displacement error was lower than 0.85 mm. The systematic movement components were lower than 0.05 mm and the random component was lower than 0.3 mm in the 3 translational axes. Clear linear time dependence was found in the random component.

**Conclusions**

Selection of the X-ray image acquisition time is necessary to meet the accuracy required for radiosurgery procedures with the CyberKnife VSI system. We verified that our image acquisition protocol met the 1-mm criterion.

**Keywords**

Robotic radiosurgery; Frameless; Intrafraction movement; Accuracy