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A Study of Dosimetric Evaluation with/without Flattening Filter in Stereotactic Radiosurgery

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INTRODUCTION

Stereotactic radiosurgery is technique that is used to irradiate a high radiation dose to small intracranial lesions in a single treatment. Radiosurgery has two kind of non-flatteni ng filter based stereotactic mode and flattening filter based normal (treatment) mode.
The purpose of this work is to evaluate dosimetric aspects of SIEMENS 6MV linear acce lerator specially designed adding non-flattening filter based stereotactic mode and normal t reatment mode.

METHOD

In this experiment, the linear accelerator specially designed by Siemens (non-flattening filter) was used and the head phantom can measure dose distribution with the TLD, fil m and diode was manufactured. In order to dose distribution of each mode, head phanto m was made, in which film, TLD and diode can be inserted.
With rod-type TLD, beam profile between the stereotactic mode and the normal mode wa s compared. Calibrating 100 numbers of rod-type TLD, each 50 of those were used to st ereotactic mode and normal mode and those were arranged with 2mm width.
Researches with films are performed an axial, coronal, sagittal plane. For each research, g antry rotation angle is controlled according to couch angle. It was compared that each be am profile and isodose curve between the stereotactic mode and the normal mode, throug h the video densitometer scanning images obtained from film.

Couch	Gantry rotation	Dose
Right 30°	25° ~ 65°	40MU
	115° ~ 165°	40MU
Right 60°	25° ~ 65°	40MU
	115° ~ 165°	40MU
Left 30°	205° ~ 245°	40MU
	295° ~ 335°	40MU
Left 60°	205° ~ 245°	40MU
	295° ~ 335°	40MU

< angle of gantry rotation in linear accelerator >

According to locations of diode in phantom, the measurement of beam profile was done.
Our dosimetric aspects include measurement of depth dose, beam profile, isodose curve f or two modes at either single beam or multiple arcs. The measurements were performed with specially designed stereotactic collimator and accessory, and repeated for both stereot actic and normal mode. The sizes of collimators used in measurements were 1cm, 2cm, 3 cm.
Dosimetric results in stereotactic and normal modes were compared and evaluated with io n chamber, film, TLD, and diode detector.

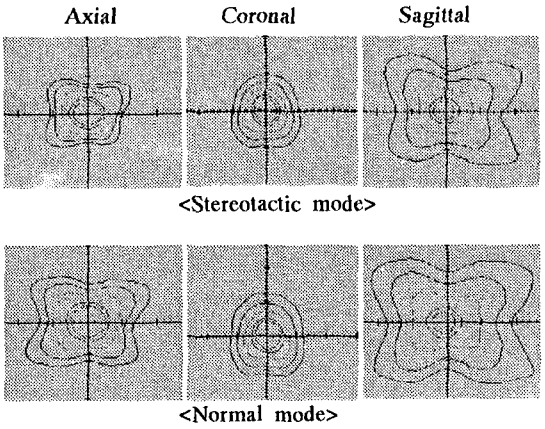
Computed isodose curves in two different modes were also compared using our developed computer radiosurgery planning system (CMC Stereo Plan).

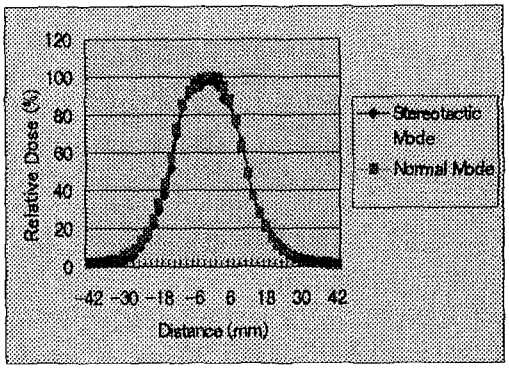
RESULT

Beam profile and isodose curve could be obtained by using TLD, diode, and film in stereotactic mode and normal mode.

There were no significant differences of beam profiles and isodose curve for both single beam and multiple arcs. In the part of the center, beam profile of stereotactic mode is lit tle sharper than that of normal mode.

Dose rates were more than 2 times higher in stereotactic mode than in normal mode.





< Beam Profile

DISCUSSION

Because the collimator size is small in stereotactic radiosurgery, the beam profile and isodose curve are not different so much between the results obtained by stereotactic mode with non-flattening filter and normal mode. The reason why the beam profile of stereota ctic mode is more sharper than that of normal mode is that flattening filter was not used in the measurement.

When flattening filter was removed, beam attenuation is decreased, so high dose rate is a cquired and consequently a result treatment time can be reduced.

CONCLUSION

There were no actual differences of dosimetric aspects between non-flattening filter ba sed stereotactic mode and flattening filter based normal mode, our stereotactic capabilities provide strong benefit of less treatment time, automatic safety set-up, and new function of patient record and verification system compatible with our stereotactic mode. As a resu lt stereotactic mode is useful for radiosurgery.