

Brain lesion radiosurgery without immobilization under continuous motion monitoring

Kenichi Saito ¹

1. Konan St.Hill Hospital CyberKnife Center

✉ **Corresponding author:** Kenichi Saito, conan@snow.plala.or.jp

Categories: Medical Physics, Radiation Oncology

Keywords: Stereotactic Radiosurgery, brain tumors, motion management, cyberknife, target locating system

How to cite this abstract

Saito K (June 16, 2016) Brain lesion radiosurgery without immobilization under continuous motion monitoring. Cureus 8(6): a126

Abstract

Objectives: Cyberknife (CK) uses the target locating system (TLS) to determine the precise coordinate of the patient head position without rigid frame fixation. The patient must keep still until the finish of each treatment beam. However, TLS verification is intermittent usually just before each beam delivery. The latency until robot manipulator re-positioning, adding the finish of each treatment beam, no feedback of the patient position makes blind time. Also TLS cannot catch up with the unexpected abrupt motion like cough. The large position change between TLS image acquisition may manifest the misalignment of the beam retrospectively by the next TLS. In this context, continuous real time patient position monitoring will compensate this blind time. To resolve these blind time, we developed the continuous motion monitoring tool (CMM). Detail for the CMM with shell fixation is reported by K Saito, Neurosurgery 64:A110-122, 2009.

Methods: The vacklock is made to fit the patient head shape at the CT study. During the treatment, two plastic buttons are patched directly to the patient's glabella and the temple connected to the 4 encoders (R, L,D,S direction). The motion of the patient head is monitored from 4 direction of the silk thread with the 4 encoders (R, L, D, S). The potentiometer keep detecting the change of the thread length 4-12 times/ sec (maximum 30 times/sec) with 0.01 mm increment throughout the treatment process. CMM is interlocked and makes emergency stop (ESP) at the head motion any of (R, L, D, S) direction. Any of CMM parameter gets beyond the limit set by the operator (default 0.5 mm), CMM sends ESP signal immediately to the CK to pause the treatment process, and TLS can re-verify the patient position. During the treatment, CMM parameters are reset to zero at each TLS X-ray image acquisition. After the locked position by each TLS image acquisition (the beginning of the blind time), CMM starts the new patient motion monitoring until the next image verification by TLS. The film head phantom was used to determine the correlation of parameters between CMM and TLS.

Results: The film head phantom study gave the strong linear correlation of parameters between CMM and TLS. 120 patients (Age 65±14, M/F 64/56, 86 metastatic brain tumors, 7 vestibular schwannoma, 4 meningioma, 2 AVM, 14 other tumors) were monitored by CMM during 676 CK stereotactic radiosurgery treatments. LINAC high voltage on time /treatment was 29±11 min. (14 -125 min.). ESP occurred 2.0±3.2 times (Range 0-25) / treatment. ESP triggered by abrupt head motion of R,L,D,S direction, the moved length was 2.0±3.1 mm (Average ± S.D. Range 0.5-34.1mm). TLS gives the root square mean (r.s.m.), just after the ESP but the time lag between the abrupt motion and TLS detection, the peak of spiky abrupt head motion cannot be detected by TLS. The rapid CMM response can detect the abrupt head motion and give the exact moment

Open Access

Abstract

Published 06/16/2016

Copyright

© Copyright 2016

Saito. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 3.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Distributed under

Creative Commons CC-BY 3.0

of the peak amplitude of R,L,D,S parameters. As the R,L,D,S data of CMM and TLS parameters have a strong correlation, R,L,D,S change of CMM can be translated to calculate the r.s.m. of head abrupt motion.

Conclusions: CMM serves as monitoring tool for patient head motion to improve the accuracy of stereotaxis by detecting the abrupt motion during the blind time of the CK treatment.