Table 1: The mean values of matching results

Matching Method: Translation+ Roll	Online anatomical match result (mean±SD)	Offline rod matching result (mean±SD)	True set-up error (mean±SD)	Legend
Lat. deviation (mm)	-0.25±1.4	-0.29±1.3	-0.04±0.44	+ve=Rt, -ve= Lt
Long. deviation (mm)	-0.62±0.85	-0.55±0.83	-0.07±0.45	+ve=Sup, -ve=Inf
Vert. deviation (mm)	4.1±1	4±1.1	0.12±1.1	+ve=Ant, -ve=Post
Roll deviation (degree)	0.11±0.47	0.07±0.21	0.05±0.47	+ve=Rot Lt, -ve=Rot Rt
Matching Method: Translation+ Pitch+ Roll+ Yaw	Online anatomical match result (mean±SD)	Offline rod matching result (mean±SD)	True set-up error (mean±SD)	Legend
Lat. deviation (mm)	-0.32±1.2	-0.31±1.2	-0.01±0.34	+ve=Rt, -ve= Lt
Long. deviation (mm)	-0.65±0.78	-0.60±0.83	-0.05±0.33	+ve=Sup, -ve=Inf
Vert. deviation (mm)	4.2±0.91	4±0.94	0.19±0.74	+ve=Ant, -ve=Post
Pitch deviation (degree)	0.05±0.11	0.07±0.13	-0.02±0.09	+ve=Pitch down, -ve= Pitch Up
Roll deviation (degree)	0.09±0.31	0.02±0.22	0.07±0.31	+ve=Rot Lt, -ve=Rot Rt
Yaw deviation (degree)	-0.04±0.37	-0.05±0.36	0.02±0.15	+ve=Yaw Lt, -ve=Yaw Rt

Conclusions: The mean values of online and offline matching results were within the tolerance of SRT in all directions, except in the vertical direction. However, the mean true set-up error of the vertical direction was within the tolerance. It was observed in both matching methods due to the different fixation applied between the planning CT table and the tomotherapy table. The one used for the planning CT was locked at the side of the couch while the one for tomotherapy was fixed by 'Plug-in' features on the couch top. This difference introduced the systematic error in the vertical direction. Previously, stereotactic radiosurgery (SRS) required the invasive fixation of the cranium, which was a traumatic procedure for the patient, with no image verification for the treatment position. The treatment accuracy was dependent on precise pre-treatment QA. The GTC headframe is suitable for precise SRS & SRT because the true set-up error is within sub-millimemter and well below the tolerance. Nowadays, image-guided tomotherapy combined with GTC headframe could benefit radiosurgery. It allows 3D monitoring of the actual treatment position and online correction of both systematic & random errors. The non-invasive GTC headframe, together with tomotherapy, could be the breakthrough of radiosurgery.

EP-1124

Cyberknife radiotherapy for spine metastases: feasibility and acute toxicity.

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Purpose/Objective: Traditionally, spine metastases (mets) have been treated at the European Institute of Oncology, Milan, Italy, with 3-dimensional conformal radiotherapy and conventional regimens. In 12/2011 CyberKnife Unit was installed in EIO. Based on the literature data, CyberKnife streotactic radiotherapy (CBK-SRT) for spine mets was undertaken in our Institute in 2/2012. The objective of this retrospective study is to evaluate feasibility and acute toxicity of CBK-SRT for spine mets in the first 8 months of clinical activity of the EIO CyberKnife.
Materials and Methods: Inclusion criteria: 1) adult patients; 2) with limited (oligometastatic) cancer involving spine; 3) that underwent CBK-SRT at EIO between 2/2012 and 10/2012 and 4) gave written informed consent for the treatment. Previous radiotherapy or concomitant systemic therapy was allowed. Treatment protocol: Contouring was based on the computer tomography (CT) and contrast medium magnetic resonance (MR). Treatments planning were performed using a MultiPlan® 4.5 treatment planning system (Accuray, Inc.). The Sequential Optimization inverse planning algorithm was used: treatment plan typically involve 100-200 beams, using 1-3 fixed circular collimators, which range in size from 5-60 mm. Tumour motion was tracked using a Xsight Spine tracking methods: this system localizes spinal targets by direct reference to the adjacent vertebral elements with sub-millimeter accuracy. Clinical monitoring: CBK-SRT was performed on the out-patient basis. Steroid premedication was administrated. Toxicity was evaluated with use of Radiation Therapy Oncology Group/European Organization for Research and Treatment of Cancer (RTOG/EORTC) criteria.
Results: Between 2/2012 and 10/2012 consecutive 49 pts were treated: primary diagnosis included breast (29 pts), urology (13 pts), lung (3 pts) and other malignancies (4 pts). Median age was 61 years (range, 38-88 years).CBK-SRT consisted in first radiotherapy and re-irradiation in 3 spine mets, respectively. In 1 pt 2 spine mets were treated concomitantly. In 50% of treatments, CBK-SRT was delivered in 2 fractions. Median CBK-SRT dose was 18 Gy (range, 6-24 Gy)/2 fractions (range, 1-3 fractions). Overall CBK-SRT duration was 1-8 days (median 2 days). All patients completed planned CBK-SRT and only one acute event was registered: a patient treated for dorsal spine met complained temporary chest pain (cardiological examination in the Emergency Dept. showed high blood pressure and normal electrocardiogram, so the patient was discharged).
Conclusions: CyberKnife-based SRT is a feasible approach for limited spine metastatic disease offering short and well accepted treatment with low toxicity profile. Further investigation is warranted to evaluate tumor control and late toxicity. The optimal schedule and combination with systemic treatment should also be defined.

ELECTRONIC POSTER: CLINICAL TRACK: TARGET AND VOLUME DEFINITION AND IMAGING

EP-1125

Optimization of CT/MR image fusion protocol for GTV contouring in head and neck cancer: results of a prospective study

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Purpose/Objective: The aim of this study was to evaluate the accuracy of a CT/MR image fusion protocol for GTV contouring in Head and Neck Cancer by analyzing the data set of measurements in a prospective series of 10 patients (pts).
Materials and Methods: Between 2011 and 2012, 8 pts with oropharynx and 2 pts with nasopharynx locally advanced squamous cell carcinomas receiving radical IMRT-SIB entered a prospective study to evaluate a protocol for CT/MR image fusion for GTV delineation. All pts got CT-simulation on a 16 detector lines spiral CT: 3 mm slice thickness, 0 mm gap, in supine position with headrest and a five-point thermoplastic immobilization mask. Three superficial markers were positioned on the mask at the intersection of sagittal and medial lasers; images were acquired from the vertex to the thoracic inlet. Pre/post-contrast MR was performed on 1.5 T machine with head and neck coil, according to a dedicated diagnostic protocol. Since the immobilization system device did not allow the head and neck coil, the diagnostic MR was thereafter completed with 2 axial sequences acquired in treatment position with the headrest but without mask, alignment done with MR lasers, skin markers coincident with those positioned before CT-simulation. A superficial 'phased array' coil made of 2 elliptical elements (11 x 14 cm) was used and T1 TSE / T2 TSE sequences were acquired in the same axial plane and with the same thickness/gap as of CT. An automated rigid system based on mutual information transformation algorithm was used for image-fusion of CT and the 'phased array' coil - acquired MR sequences. Coregistration accuracy was preliminary determined in a lucite cylinder phantom containing plexiglas sticks and filled with a 3mM $CuSO_4$ solution. The geometrical accuracy in each patient was then evaluated by analyzing differences in the position of five anatomical bone markers identified by a single observer on CT/RM images.
Results: In the phantom, for T1 TSE sequence the mean of differences in mm along the 3 spatial directions x, y, z was 0.2 (0.0-0.5), 0.3 (0.0-0.9) and 0.8 (0.0-2.0), respectively; for T2 TSE: 0.0 (0.0-0.2), 0.1 (0.0-0.3) and 0.8 (0.0.1.4), respectively. No distortion effects were observed in both MR sequences. In the 10 patients the mean differences in mm along the 3 directions, x, y, z, were 0.0 ± 2.4 SD, 1.6 ± 2.5 SD, 1.4 ± 3.4 SD, respectively. The mean of spatial differences between CT/MR image sets was 4.4 mm ± 2.9 SD, with the highest values found in the z direction (cranial-caudal), due to lower spatial resolution of both image sets (3 mm thickness). When considering only x and y directions the differences were < 3 mm. For GTV contouring, T2 TSE sequences were selected in 7/10 pts with deep infiltrating tumours, T1 TSE in 3/10 pts with superficially diffuse tumours.
Conclusions: The protocol used in this study has shown a good accuracy of our CT/MR coregistration procedure. A new study is ongoing to compare these results with those obtained with a non-rigid image fusion system.