a combination of a removeable Iridium 192 interstitial implant (15 Gy/5 Gy single dose/3x week) and external beam irradiation (77 Gy, range 60-85 Gy). Seventeen out of 68 (25%) patients underwent resection prior to radiation, however, surgery was microscopically complete only in 7 of them. Distribution according to UICC T1, T2 and T3+T4 showed 6 (9%), 13 (19%) and 49 (72%) patients. The mean age was 59 years (range, 39-88). Fifty-four (79%) patients presented with lymph node involvement. Afterloading technique was applied in 55 patients for the primary tumor, in case of unknown primary interstitial brachytherapy of the enlarged lymph nodes was performed. No patient showed up with distant metastases at time of first diagnosis.

Results: Only 16 (24%) patients had a locoregional recurrence after treatment. Combined radiation was successful in 52 (76%) cases. The overall 2-year survival was 32%, the disease free survival 45%, respectively. The mean follow-up time was 10.3 months, respectively, with a range of 1-96 months. We only observed acute side effects grade 1+2, but for delayed toxicity, 3 patients showed up with a fistula.

Conclusion: Interstitial HDR brachytherapy followed by external beam radiation is a safe and efficacious treatment combination and carries a small risk for complications.

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The interfractional three-dimensional reproducibility of a frameless stereotactic radiotherapy system

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Purpose: Fractionated stereotactic radiotherapy (FSRT) has two advantages: mechanical accuracy resulting from stereotaxy and a radiobiological advantage resulting from fractionation. The development of a relocatable frame and frameless system made FSRT possible and increased its popularity. However, there is debate over whether the setup accuracy of FSRT systems is comparable to that of stereotactic radiosurgery (SRS) systems. We evaluated the interfractional three-dimensional reproducibility of a frameless FSRT.

Materials and Methods: Between April 1999 and March 2001, we performed FSRT on 14 patients with various intracranial tumors using the pReference SRS system (NMPE, USA). Treatment was determined by the shape and volume of the tumor, and the location of critical organs. We chose multiple arc FSRT when the tumor was spherical or less than 3 cm in size, and conformal FSRT when the tumor was very irregular or larger than 4 cm. Using the program ISOLOC, we obtained three pieces of information: 1) the couch translations required to bring the target point to the isocenter, 2) the distance between stereotaxy markers in the CT study and the distance between the markers as determined from orthogonal beam films taken in the anterior-posterior and lateral directions, and 3) the rotational movement of the head position between the CT study and treatment. We evaluated two kinds of error: 1) the reproducibility of the isocenter in the interfraction, and 2) patient displacement in the a) translational and b) rotational components, using orthogonal films between the target coordinates and isocenter coordinates in the interfraction.

Results: The interfractional reproducibility of the isocenter relative to the planned treatment was $x = 0.0 \pm 0.3$ (mm), $y = 0.1 \pm 0.4$ (mm), and $z = 0.0 \pm 0.3$ (mm). The magnitude of patient displacement in interfractionation was less than 0.5 (mm) for the translational component and less than 1° for the rotational component.

Conclusions: The reproducibility of the interfraction on patient-displacement-induced translational and rotational error was in the acceptable range for FSRT. We believe that the setup accuracy of our FSRT system is comparable to that of a SRS system.

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CT-MR-SPECT fusion based on a vacuum-dental frame and its application in RT planning, -treatment and -follow-up

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Purpose: CT, MR and SPECT/PET data can offer important information in diagnosis, treatment and follow-up of tumors. While various methods of fusing CT and MRI have been developed and offer satisfactory results, the possibility of assigning functional information of SPECT/PET images to precisely defined anatomical structures remains a challenge. We present the relevance for radiotherapy of a simple, reliable, precise and non-invasive method of combining functional and anatomical modalities on a case report of a 52 year old woman with optic nerve meningeoma.

Materials and Method: 3D dataset acquisition is performed with a reference frame (SIPLab Innsbruck Frame) with 11 modality-specific markers in precisely defined positions. This frame is reproducibly connected to the Vogele Bale Hohner (VBH) vacuum- mouthpiece, which allows objectively identical repositioning of the frame with respect to the head. The desired 3D imaging modalities can then be manually (SPECT-CT/MR:paired-point matching) or automatically (CT/MR:voxel based) fused using commercially available planning software. The same vacuum MP can be used for reproducible head fixation during treatment.

Results: 21 patients have been treated and followed using the above method.

As an indicator of registration accuracy, the RMSE (root mean square error) of all 117 datsets registered via the external landmarks was 0.9 mm for CT-MR and 1.4 mm for SPECT-CT fusion. No measurable deviations occurred in automatically merged CT/MR datasets unless head position in the respective scanners differed greatly, requiring use of external markers for registration. Fusion per data-pair requires <5 minutes.

A representative pictorial case report of a 56 year old female with optic meningeoma, whose loss of functional activity (SPECT) of the tumor after 50 Gy corresponded with an impressive recovery of eyesight, is presented. Activity in the parasagittal frontal region with no CT/MRI correlate remains in observance during follow-up.

Conclusion: This method is a simple and accurate tool to combine 3D diagnosis, treatment planning, treatment and follow-up (as fourth dimension),all via a vacuum mouthpiece. In the scope of a unified approach in the treatment of cranial tumors at this institution, the same vacuum-MP and frame are used for frameless stereotactic biopsy and neurosurgery in select cases.

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Development of a new linac system combined with a self-moving CT and a single common couch

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Purpose: To evaluate the performance of our new linac system combined with a self moving gantry CT with a single common couch.

Materials and Methods: To carry out CT-guided frameless stereotactic irradiation(STI) precisely, we have developed a new linac system. We used a single common couch, and placed the linac on the opposite side of the CT which has a self moving gantry. When we turn the couch 180 degrees, the zero position of the CT corresponds to the isocenter of the linac. For CT, we used HiSpeed DX/i (GE Yokogawa Medical Systems, Tokyo,Japan). The diameter of gantry mouth is 70cm. Scan range is 180cm. To obtain CT images, the gantry moves along the rails instead of the couch moving into the gantry as in conventional CT. We can obtain information about the gantry position from the magnetic linear scale, which is parallel to the rails on which the gantry moves. The couch itself is made of carbon. It is 40cm wide, 210cm long, and has a maximum thickness of 10cm. It can be moved 320mm in the vertical direction, and 110mm in the lateral direction in the gantry mouth of the CT. We use this couch for both CT scanning and irradiation. For linac, we used EXL-15DP(Mitsubishi Electric, Tokyo, Japan). In daily treatment, we adjust the patient(couch) position by CT images, and can make set up error minimum. To assess the performance of this system, we evaluated the accuracy of the scanning position of the CT, the accuracy of the rotation of the couch. The accuracy of the scanning position of the CT is evaluated by obtaining the CT images of crosswire phantom. The accuracy of the rotation of the couch is evaluated with CCD camera and small acrylic ball.

Results: The error in the scanning position of the CT was within 0.3mm for each perpendicular directions. The difference between the CT origin and the linac isocenter according to the 180 degree turn of the couch was within 0.2mm for lateral and vertical directions.

Conclusion: The accuracy of this system is sufficient to carry out CT-guided frameless STI. We suggest that we can carry out frameless STI accurately and non-invasively with this system. And with this system, we can perform not only single fraction STI but also fractionated STI for any lesions in body. And this system is useful for quality assurance and adjusting of isocenter for intensity modurated radiation therapy and three dimensional conformal radiation therapy.