Patient irradiations at GSI

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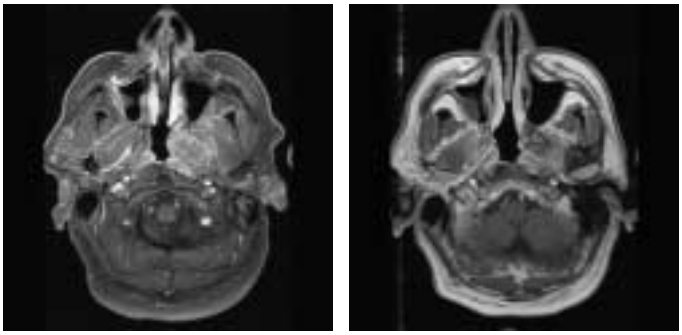
Before patient irradiations started in 1997, a radiation unit was built at the heavy ion synchrotron of the GSI and major future directed technical and radiobiological innovations have been implemented. For the first time, tumor conform application of carbon beams was realized by intensity-controlled rasterscanning with pulse-to-pulse energy variation [1]. All patients had 3D treatment planning including a biological plan optimization using the treatment planning program TRIP developed at GSI [2]. A PET camera is used for online beam verification [3].

Up to now, 73 patients with tumors of the skull base and the brain have been treated with carbon ions. The study mainly contained patients with chordomas (33) and low grade chondrosarcomas (16) of the skull base, adenoid cystic carcinomas (8) and malignant meningiomas (8). These tumors are known to be relatively radioresistant against conventional photon irradiation. Proton radiotherapy has been shown to improve outcome in chordomas and low grade chondrosarcomas [4] but its availability is limited. In adenoid cystic carcinomas radiation therapy with heavy particles as neutrons results in improved local control rates compared to photon irradiation but causes severe side effects [5]. Malignant meningeomas commonly recur within the former irradiated fields even after high tumor doses. Carbon ion therapy presents a promising therapy option in the management of these tumors.

Within the feasibility study, median tumor dose was 60 GyE in chordomas and chondrosarcomas. Patients with adenoid cystic carcinomas and malignant meningiomas received fractionated stereotactic photon irradiation at Heidelberg University with a median dose of 50.4 Gy and a carbon ion boost with 18 GyE (6 x 3.0 GyE) to the gross tumor. Feasibility of this new therapy approach has been shown. First results are very promising with a local control rate of 94% at 1 year [6]. We observed a partial tumor regression in 7 of 33 patients treated for chordoma indicating that carbon ion therapy is effective in these tumors (figure 1+2). Tumor regression in chordomas is a finding which is rarely reported in literature after any kind of radiation therapy. Besides, active beam delivery using raster scanning allows for highly conformal dose distributions and therefore results in an optimal sparing of neighbouring normal tissue. The low toxicity rate allows further dose escalation. As a consequence the total tumor dose has been escalated from 60 GyE to 70 GyE for chordomas and chondrosarcomas in the following phase II study which has been activated in November 2000. A rigid immobilization device developed by Lohr et al.at DKFZ [7] has been tested at GSI and will guarantee the safe irradiation of extracranial tumors. In 2001 a phase I/II study for the treatment of sacral / spinal chordomas and low grade chondrosarcomas will be activated. Furthermore, photon irradiation with a carbon ion boost will be available within a clinical phase I/II study for adenoid cystic carcinomas in 2001.

Figure 1+2. Chordoma of the skull base a) prior to RT, b) 3 months after RT with carbon ions.



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