

Aichi Cancer Center & IMRT

Facing a changing cancer landscape with a future-focused solution

Intensity-modulated radiation therapy (IMRT) is not a common treatment option in Japan. According to a 2008 survey, of the more than 900 radiation treatment centers in Japan, less than 60 provide IMRT. Physicians in Japan tend to be very conservative regarding radiation therapy in general, and this has led to a low adoption rate for IMRT. Several other factors play into this situation: demographically, gastric and colorectal cancers are common, and surgical treatment has been the first choice for these patients.

Furthermore, insurance coverage for IMRT applies to only a limited range of disease types (such as head and neck, brain, and prostate cancer), and only at a limited number of facilities. Of the institutes found to be offering IMRT, less than 40 are currently able to receive reimbursement for this mode of treatment. A major limitation for the widespread application of IMRT is lack of staff with specialty training: there are currently only about 500 JASTRO-certified radiation oncologists in Japan, and medical physics services are mostly provided by technicians rather than physicists.

Dr. Takeshi Kodaira of the Aichi Cancer Center thinks this situation is about to change, with radiation therapy—and increasingly IMRT—playing a larger role for cancer treatment in Japan. “The number of patients with prostate, breast, and lung cancer has been growing,” he notes, “so I think the need for radiation therapy is increasing dramatically.” He adds, “Now many surgeons operating on thoracic malignancies (esophagus and lung) think radiation treatment is a very efficacious modality.” For prostate cancer in particular, the radiation treatment modality of choice is more and more likely to be IMRT.

The Aichi Cancer Center, in the city of Nagoya, is one of 14 facilities offering TomoTherapySM treatment in Japan and is the only public hospital to have the technology. Since installing the TomoTherapy[®] Hi-Art[®] treatment system in 2006, the radiation therapy department has treated an increasingly wide range of cases on the system, including prostate, head and neck cancers, brain



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metastases, lung cancer and other malignancies. “We use the *Hi-Art* treatment system to deliver IMRT for a great variety of different cases,” Dr. Kodaira observes. “With *TomoTherapy*, we are expanding the therapeutic windows for both definitive and palliative treatment.”

Of the cases treated with the *Hi-Art* treatment system at Aichi, about 40 percent are patients with prostate cancer—a much greater proportion than most other hospitals in Japan. Dr. Kodaira attributes this to the clear benefits that the *TomoTherapy* platform’s integrated image guidance offers for prostate treatments, explaining that “*TomoTherapy* delivers very conformal dose, and the daily image guidance is very powerful, enabling accurate patient set-up.” He notes that daily imaging with the *Hi-Art* treatment system helps to avoid the side effects that can sometimes occur with other forms of IMRT. “I have rarely seen grade 3 rectal bleeding for patients treated on the *Hi-Art* treatment system,” he explains. “*TomoTherapy*’s image-guided radiation therapy (IGRT) solution is very practical and helps keep treatment safe for patients.”

In fact, so many patients are opting for *TomoTherapy* treatments that there is currently a 10-month waiting period for prostate treatments. During that time, Dr. Kodaira explains, patients are monitored and use neo-adjuvant hormone therapy to keep the disease stable. If the PSA levels begin to rise, the patient is given priority to begin radiation treatments.

Dr. Kodaira sees the *Hi-Art* system’s ability to monitor and adapt for inter-fraction changes in patient anatomy as a major benefit for treating patients with head and neck cancers. Dr. Kodaira and his team have established a protocol for head and neck cancers in which they acquire a new planning CT midway through the course of treatment. The new scan is used to precisely evaluate any changes in delivered dose due to factors such as weight loss during the course of treatment. In more than 10 percent of the cases, these changes have warranted a new plan to maintain the prescribed dose to the tumor and/or limit dose to the brain stem or optic nerve.

Dr. Kodaira’s team also uses the *TomoTherapy Hi-Art* system to deliver complex treatment plans for brain metastases, using a simultaneous integrated boost (SIB) technique. With an SIB plan, different doses can be prescribed to separate target volumes, each with a distinct dose per day. With this approach, the patient can receive different total doses to independent target areas, on the same number of treatment days, rather than

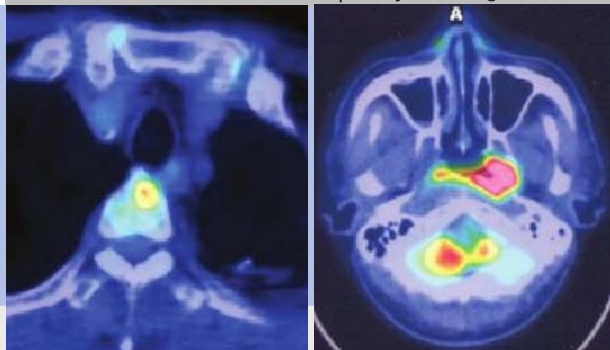


having to undergo additional days of treatment to boost the areas requiring higher doses. As Dr. Kodaira observes, “The *TomoTherapy* system can treat widespread lesions at several sites efficiently, allowing us to treat patients with large or multiple metastases who are not candidates for other forms of IMRT.”

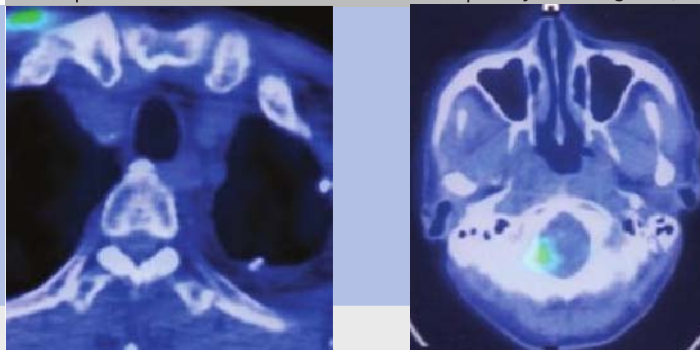
The Aichi team is working to expand the role of IGRT in Japan. Dr. Kodaira has published widely on the topic, including recent articles on *TomoTherapy* in the *British Journal of Radiology*, *International Journal of Radiation Oncology-Biology-Physics* and *Technology in Cancer Research and Treatment*. Physicians in Japan must get permission from the Ministry of Health, Labor and Welfare before they are allowed to apply new clinical protocols for patients with certain cancers; Dr. Kodaira and his colleagues are currently preparing for a JCOG study (Japan Clinical Oncology Group) on IMRT combined with chemotherapy for nasopharyngeal cancer. In addition, a prospective phase II study of stereotactic body radiotherapy for stage IA lung cancer has been underway since February 2009 along with Kizawa Memorial Hospital. “We are preparing to expand our use of IMRT with *TomoTherapy* to other diseases,” says Dr. Kodaira.

Case Study: SIB Technique for Nasopharyngeal Carcinoma

Pre-treatment PET-CT scans revealing increased metabolic activity in the thoracic metastasis (left) and primary tumor region (right)



Post-treatment PET-CT scans showing absence of increased metabolic activity in the prior sites of the thoracic metastasis (left) and primary tumor region (right)



CASE SUMMARY

Institution: Aichi Cancer Center, Nagoya, Japan

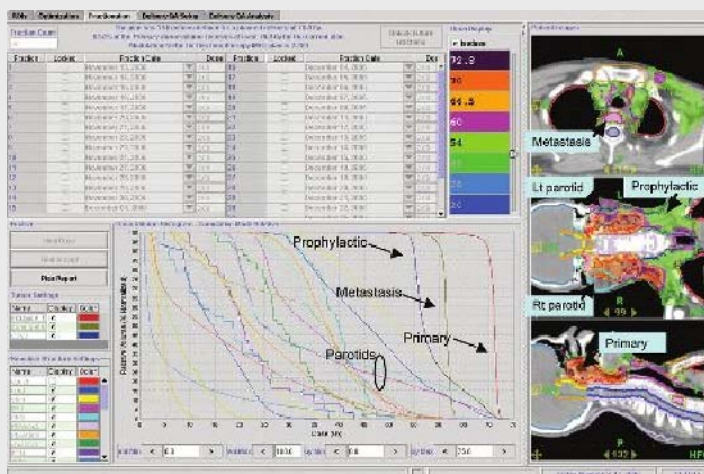
Patient: 69-year-old male

Diagnosis: T2bN2M1 stage IVc nasopharyngeal carcinoma (NPC) with a solitary thoracic spinal metastasis

Plan: 70 Gy to the primary tumor and involved lymph nodes (PTV1), 54 Gy to a prophylactic region (PTV2), and 60 Gy to the thoracic spinal metastasis (PTV3)

Treatment: The patient received the full planned dose using a simultaneous integrated boost (SIB) approach to deliver different doses to multiple targets. The patient also received two cycles of systemic chemotherapy during two six-day treatment periods prior to and after his seven-week course of *TomoTherapy* treatment. Each chemotherapy cycle consisted of:

- Five days of 5-fluorouracil (5-FU) to a dose of 800 mg/m²
- One day of Nedaplatin (NDP) to a dose of 130 mg/m²



An image from the *Hi-Art* Planning Station shows dose volume histograms (DVHs) of each target volume and organ at risk, along with isodoses overlaid on axial, coronal and sagittal images. The three right-most DVH curves indicate that the majority of each of the three target volumes receives a dose near to the respective prescribed doses (54, 60 and 70 Gy). Each target volume along with the parotid glands is indicated on the DVH and isodose displays. Note the treatment calendar indicating daily 2 Gy treatments to the primary target volume.

PATIENT HISTORY AND PRESENTATION

A 69-year-old man presenting with a cervical (neck) mass was diagnosed with stage I nasopharyngeal carcinoma. Histopathological examination revealed lymphoepithelioma, a type of nasopharyngeal cancer in which poorly-differentiated cancer cells infiltrate the lymphocytes throughout the tumor area.

TREATMENT PLAN AND DELIVERY

The plan was created using the *Hi-Art* planning system to satisfy a prescription of 70 Gy to PTV1 (primary tumor and involved lymph nodes), 54 Gy to PTV2 (prophylactic region), and 60 Gy to PTV3 (thoracic spinal metastasis) with a simultaneous integrated boost technique. Each dose level was delivered over the same

35 fractions, five days per week. The complete prescribed dose was delivered successfully over seven weeks along with two cycles of systemic chemotherapy.

OUTCOME

The patient tolerated *TomoTherapy* treatment well, with grade 2 post-IMRT xerostomia (dry mouth caused by reduced salivary function) reducing to grade 1 on later follow-up. Expected acute chemotherapy-related side effects such as leucopenia (reduced white blood cell count), anemia and liver dysfunction also occurred. More than two years after *TomoTherapy* treatment, there has been no disease progression.