

## 胸腺腫に対する放射線治療—照射線量と照射野の検討—

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## RADIOTHERAPY FOR PATIENTS WITH THYMOMA

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**Abstract:** Purpose: To evaluate the therapeutic results of radiotherapy in patients with thymoma. Materials and Methods: The records of 9 patients with histologically confirmed thymoma were reviewed. Eight patients had Masaoka's stage III disease, and one patient had stage IVb. Seven patients were treated by surgical resection with adjuvant radiotherapy, and two were treated by radiotherapy alone. Four patients were treated with localized field irradiation and 5 patients were treated with irradiation of the whole mediastinum field with or without boost field. The total radiation dose was 40-65.9 Gy, with a median dose of 50 Gy. No patients received chemotherapy during the initial treatment. Results: With a median follow-up time of 6 years, 3 patients (33%) had recurrence and one of these died of recurrent disease. Recurrence was observed in a case of unresectable disease, a patient with microscopically positive resection margins, and a patient with stage IVb disease, who received total dose of 50-56 Gy. Pleural dissemination was the most frequent pattern of recurrence, and lymphnode metastasis of neck and axilla was also noted. Patients with completely resected stage III disease received a total dose of 40-45 Gy and no recurrence was observed. With respect to treatment field, recurrences were seen in 50% who were treated with localized field, whereas 20% who were treated with whole mediastinum field experienced recurrences. Conclusion: Mediastinal irradiation with a total dose of 40-45 Gy seemed to be effective in preventing recurrence for patients with completely resected stage III disease. However, in patients with close resection margins or with unresectable disease, a dose of 60 Gy and above may be required to control the initial tumor site. Moreover, mediastinal irradiation alone is supposed to be insufficient to avoid pleural dissemination or distant metastasis. A multidisciplinary approach including chemotherapy should be considered to improve the survival rate in patients with unresectable or advanced stage thymoma.

Key words: Thymoma, Radiotherapy, Radiotherapy dose, Radiotherapy fields

## 当院における悪性胸膜中皮腫に対する胸膜外肺全摘術後の 片側胸郭放射線療法

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### ADJUVANT HEMITHORACIC IRRADIATION FOLLOWING EXTRAPLEURAL PNEUMONECTOMY FOR THE TREATMENT OF MALIGNANT PLEURAL MESOTHELIOMA

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**Abstract:** Purpose: Adjuvant hemithoracic irradiation (HTI) following extrapleural pneumonectomy (EPP) for the treatment of malignant pleural mesothelioma has been reported to reduce local relapse. Reported are early results of HTI with 3-dimensional radiation therapy.

Patients and Methods: Seven cases treated with HTI following EPP from September 2005 to March 2007 were reviewed. A total of 54 Gy at the point of the reference point near the center of the body surface was delivered through anterior and posterior fields in 30 daily fractions of 1.8 Gy. However, the spinal cord was protected after 41.4 Gy. Blocks were used to limit the dose to the liver, heart, and stomach when these organs were in the treatment field. Follow-up period was calculated from the first day of radiation therapy and ranged from 251 to 1,191 days (median 591).

Results: V20 of the lung ranged from 0 to 16%, and only one case was over 7%. V30 of the liver ranged from 17 to 47%, and 4 cases were over 30%. Over all treatment time was ranged from 41 to 47 days. Only one case developed G3 toxicity (alkaline phosphatase elevation). Pulmonary toxicity greater than G2 was not observed. Four cases relapsed, and three of them were within the thorax.

Discussion and Conclusion: Liver dose treated by HTI following EPP was relatively high. Intensity modulated radiation therapy results in superior dose distribution compared with 3-dimensional radiation therapy. Further research to determine more precise lung dose is also necessary.

Key words: Malignant pleural mesothelioma, Extrapleural pneumonectomy, Hemithoracic irradiation, 3-dimensional radiation therapy

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## 乳房温存療法の接線照射におけるくさびフィルタの選択

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## SELECTION OF WEDGE FILTER IN TANGENTIAL IRRADIATION OF CONSERVATIVE TREATMENT OF BREAST CANCER

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**Abstract:** The entire breast is targeted for irradiation in breast-conserving surgery. Ipsilateral lung and cardiac tissue are partially included in the field. Because the shape and size of the breast takes in a personal preference, it is often difficult to adjust a wedge filter for making adequate isodose distribution. Therefore, we devised a simple and manageable method to select optimal wedge filter depending on shape of the breast.

**Methods:** The breast at the central axis of the tangent portal field, including a reference point, was assumed to be a triangle. The area of this triangle was calculated as a PTV volume. The PTV length (DP) is the distance in the projection of the tangential field, which was from the apex of the triangle to the posterior tangential field edge. The lung distance (DL) is the width of lung in the tangent portal field at the triangle. We examined whether the use of DP and DP/DL parameters allows selection of optimal wedge filters.

**Results:** The area of assumed PTV and irradiated lung had a strong relationship with DP and DL, respectively. We determined the degree of a wedge-filter for  $D_{max} < 110\%$ . We found the optimal wedge using the value of DP and DL/DP. The selected wedge filters were 0° and 15° wedges in the case of more than 0.5 of DL/DP and  $0.33 < DL/DP \leq 0.5$ , respectively. With less than 0.33 of DL/DP and more than 6.5 cm of DP, a 15° wedge was suitable. In addition, a 30° wedge was selected for the patients with less than 0.33 in DL/DP and  $< 6.5$  cm in DP.

**Conclusion:** Our study suggests that a suitable wedge-filter can be determined by measuring DP and DL.

**Key words:** Radiotherapy, Wedge filter, Breast conservative therapy

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## 非侵襲的呼吸同期照射に向けた腹壁運動と肺腫瘍運動との相関解析

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CORRELATIVE ANALYSIS OF ABDOMINAL MOTION WITH LUNG TUMOR  
MOTION FOR NON-INVASIVE RESPIRATORY GATED RADIOTHERAPY

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**Abstract:** Purpose: The purposes of this study were to assess the correlation between lung tumor motion and the abdominal motion, and to estimate the position mismatch as the difference between the abdominal motion trace used to the predicted lung tumor position and the measured lung tumor position.

Methods and Materials: Eleven patients who underwent stereotactic body radiotherapy between December 2006 and March 2008 were included in this study. Of all the patients, 6 were studied over 3 days under an internal review board approved protocol. Breathing synchronized fluoroscopy was performed under free breathing. Measurements of the anterior-posterior abdominal skin surface displacement by the Real-time Positioning Management System (Varian Medical Systems, Inc., Palo Alto, CA) were correlated to simultaneously acquired X-ray fluoroscopy (Acuity; Varian Medical Systems, Inc.) measurements of superior-inferior tumor displacement. The lung tumor motion was analytically detected by a template matching algorithm after image processing. To evaluate the tumor-abdominal motion phase relationship, a cross-correlation was calculated of the time-synchronized tumor motion and the abdominal motion. By comparing the predicted lung tumor position in which phase difference was corrected to the measured lung tumor position, the position mismatch was computed.

Results: The correlation coefficients between the lung tumor motion and abdominal motion ranged 0.89 from 0.97 and more reproducible from day to day. A hysteresis curve was observed due to phase difference between the lung tumor motion and abdominal motion. The average of the position mismatch was up to 1.78 mm.

Conclusion: Even if the correlation coefficients between the abdominal motion and the tumor motion were high for most cases, there were some differences between the predicted lung tumor position and the measured lung tumor position.

Key words: Respiratory gated radiotherapy, Lung tumor motion, Respiration surrogate

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## 直腸癌術後再発に対するPET/CT planningに関する初期研究 ～GTVとBTVの相違～

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### THE DIFFERENCE BETWEEN GROSS TUMOR VOLUME AND BIOLOGICAL TARGET VOLUME IN POSTOPERATIVE LOCAL RECURRENT RECTAL CANCER; A PRELIMINARY STUDY OF PET/CT RADIATION THERAPY PLANNING

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**Abstract:** Purpose: To reveal the difference of gross tumor volume (GTV) in CT with biological target volume (BTV) in positron emission tomography using 18F-fluorodeoxyglucose with computed tomography (FDG-PET/CT).

Materials and Methods: In 7 patients with postoperative local recurrence rectal cancer, three independent radiation oncologists delineated target volume on CT and PET, respectively, and compared the volume of GTV with that of BTV using the two-factor repeated measures ANOVA. FDG-PET/CT was performed in the same position as radiotherapy. The images by CT and PET were sent to the radiation therapy planning system as the DICOM datum, respectively, and fused those images using DICOM information. Each radiation oncologist delineated the abnormal shadow on CT as GTV and delineated macroscopically the region with high FDG accumulation using the tumor/muscle ratio.

Results: In those seven patients, mean GTV was  $77.2 \pm 53.6$  cm<sup>3</sup> and mean BTV was  $58.0 \pm 48.0$  cm<sup>3</sup>, and BTV was statistically smaller than GTV ( $p < 0.001$ ). There was a strong correlation between GTV and BTV ( $r = 0.952$ ,  $p < 0.001$ ). In patients with local recurrent rectal cancer, there were no significant differences among radiation oncologists ( $F(2, 18) = 0.654$ ,  $MSe = 5220.046$ ,  $p = 0.532$ ).

Conclusion: There was a significant difference between the target volume on functional image (PET/CT) and the target volume on morphologic image (CT) in the patients with local recurrent rectal cancer.

Key words: PET/CT radiation therapy planning, Recurrent rectal cancer, Biological target volume

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