

## 早期肺癌の定位放射線治療における線量精度の品質保証

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### VERIFICATION OF THE THERAPEUTIC STEREOTACTIC IRRADIATION (STI) DOSE FOR EARLY LUNG CANCER

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**Abstract:** Stereotactic irradiation (STI) therapy has recently been reported to be effective for early lung cancer and possible to be decreased in harmful side effects. This treatment included a high dose per fraction with hypo-fraction compared to a dose of conventional irradiation. If the dose-precision of STI for lung cancer was not corrected, the treatment possibly resulted in the decline in the therapeutic effect and the increase in a harmful matter. The lung is a hypo-density structure consisting of air and the irregular alveolar organization. It is very difficult to calculate the correct therapeutic dose in STI therapy using non-coplanar, irregular fields and multi-direction. So, we originally produced an irregular density phantom which was on-line taken in the treatment planning system as computed tomographic images. Then the plan was rewritten and recomputed on the phantom, and we compared the recomputed doses with measured dose. We started the STI treatment, when the discrepancy is within plus/minus 3 %.

Key words: QA, STI, Lung, Cancer, Phantom

## 頭頸部癌に対する強度変調放射線治療 2 方向 X 線透視による位置補正法の応用

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### INTENSITY-MODULATED RADIATION THERAPY (IMRT) FOR HEAD AND NECK REGION

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**Abstract:** Intensity-modulated radiation therapy (IMRT) can produce highly conformal dose distributions. In head and neck region, IMRT has been used for the purpose of reduction parotid glands dose. Generally accepted, more precise set-up and careful observation are needed for IMRT than those of conventional RT, because it takes longer treatment time for IMRT and its dose gradient spreads within field.

Our institute has developed real-time tumor-tracking (RTRT) systems and it realizes precise set-up and observation during treatment. We have used IMRT with RTRT system for head and neck region for 9 patients with 3-mm as the planning target volume margin. Salivary glands function was evaluated by subjective symptoms using visual analogue scale (VAS).

After median follow-up of 17 months, all patients were alive without local relapse and distant metastasis. The mean VAS score of each periods were 9.6, 51.4, 55.1, 39.7 and 47.9 mm at pre-treatment, 1-4 months, 5-8 months, 9-12 months, and 13 months or more after the radiotherapy respectively. IMRT with RTRT set-up system was shown to be feasible.

Key words: Intensity modulated radiotherapy, Real-time tumor-tracking radiotherapy, Head and neck cancer

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## 頭頸部IMRT(Intensity Modulated Radiation Therapy)における 経時的な頭頸部領域体積の変化と線量分布への影響

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### CHANGES IN REGIONAL BODY VOLUME AND GROSS TUMOR VOLUME AFFECT DOSE DISTRIBUTION DURING IMRT FOR HEAD AND NECK CANCER

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**Abstract:** Purpose: Many patients experience tumor shrinkage and/or weight loss during the course of radiotherapy. Our aim is to evaluate the dosimetric changes in tumors and organs at risk (OAR) during the course of intensity-modulated radiation therapy (IMRT) for head and neck (H & N) cancer.

Method and materials: We compared the volume and dose parameters at the dose of 0 Gy and 40Gy in ten patients. By using a commercial inverse IMRT planning system, the 0 Gy IMRT plan for each patient was generated based on the original planning CT scan acquired before the start of treatment. The 40 Gy IMRT plan was generated by applying the beam configurations of the 0 Gy IMRT plan to the anatomy of the CT scan obtained at the doses of 40 Gy. The dose-volume histograms of the 0 Gy and 40 Gy IMRT plans were compared. Results and Discussion: All patients had locally advanced, nonmetastatic diseases including 3 cervical esophagus, 3 oropharynx, 2 epipharynx and 2 unknown primary site. The regional body volume and body weight decreased in all patients. Gross tumor volume (GTV) decreased by 32 % at most. Conformity index (C.I.) increased with decrease of GTV. Parotid gland volume decreased but the dose to 50 % of the volume (D50) did not change. The maximum dose (Dmax.) to the spinal cord significantly increased in all patients (mean: 12 %, p=0.0013). The 40 Gy IMRT plan is a hybrid plan without planning a new IMRT plan and should be generated several times during the course of IMRT for H & N cancer.

Key words: Head and neck cancer, IMRT, Dose distribution

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## MCNPモンテカルロコードを用いた<sup>60</sup>Co照射装置のスペクトルと出力計算

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### <sup>60</sup>Co ENERGY SPECTRUM AND OUTPUT CALCULATION BY USING MCNP MONTE CARLO CODE

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**Abstract:** In a field of the recent medical care, linear accelerators are mainly used as an external beam radiotherapy device. On the other hand, cobalt-60 irradiation apparatuses are used for dose calibration of absolute dosimeters such as ionization chambers because of its good stability and clearly known energy spectrum comparing with those of linear accelerators. At the Research Institute for Radiation Biology and Medicine, Hiroshima University, a cobalt-60 apparatus (111 TBq) has been installed for the use of radiation biology study. We calculated basic output characteristics of this cobalt-60 irradiation apparatus using the Monte Carlo MCNP code. The energy spectrum of the cobalt-60 was used as an input of the MCNP code and, output factor (OPF) and percentage depth dose (PDD) were obtained as basic characteristics. We compared calculation with the measured results using a tertiary standard ionization chamber. The agreement between the calculation and measurements were less than 4.8%. Also in the case of this cobalt-60 apparatus low dose-rate experiment sometimes performed to irradiate cells, mice and etc. To reduce the dose rate, Pb plates were used. In this paper we calculated such spectra after absorption of the Pb plates to obtain the aspects of the scattering gamma rays. Actual energy spectra in the phantom etc. are not easy to measure. However sometimes it is necessary to know energy spectra to understand dose distribution or such characteristics precisely. In future this method will be widely used for the output calculation and for quality assurance (QA) and quality control (QC) of radiotherapy treatment planning system.

Key words: Quality assurance, Monte Carlo, MCNP, <sup>60</sup>Co

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## 骨髓移植に伴う全身照射における補償フィルターの検証方法について

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## VERIFICATION METHODS OF A COMPENSATION FILTER IN WHOLE BODY IRRADIATION WITH BONE MARROW TRANSPLANTATION

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**Abstract:** Total body irradiation (TBI) is performed before bone marrow transplantation (BMT) in case of leukemia. Uniform doses along the center of patients are essential in TBI. Differences of body thickness are compensated. In our facility, lead sheets of different thickness is used for compensator filters. Purpose of this paper are to evaluate the accuracy of our compensator system by means of checking doses along the center of the body during TBI. Eight semiconductor surface dosimeters (DPD-510 dosimeter) were used. A special holder was made of wood. An adsorbed dose in eight points along and over body was able to be measured. Compensator filters at various parts of patients' body were able to be checked before TBI. Repeated evaluation made the compensator filters perfect. A dose monitor was able to check in real time during TBI. An adsorbed dose coincided to a prescription dose. Our method is useful for improvement of accurate and homogenous dose distribution in TBI.

Key words: Bone marrow transplantation, Total body irradiation, Compensation filter

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浸潤性膀胱癌に対する経尿道的腫瘍切除後の  
low-dose Cisplatin 動注化学療法併用放射線療法の検討

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A RESULT OF INTRA-ARTERIAL LOW-DOSE CISPLATIN COMBINED WITH  
IRRADIATION AFTER TRANSURETHRAL SURGERY FOR  
INVASIVE BLADDER CANCER

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**Abstract:** Background: The combination of radiotherapy and cisplatin-based chemotherapy has proved to be an effective treatment for bladder carcinoma in many clinical studies. Intra-arterial approaches to chemotherapy have been developed to reduce systemic toxicities and improve response rates. This study was designed to determine the effectiveness of intra-arterial chemotherapy combined with radiotherapy in the treatment of patients with invasive bladder carcinoma. The objectives were to evaluate the response rate, toxicity, and survival rate.

**Materials and Methods:** Twenty-three patients with invasive bladder cancer at clinical stage T2-4 N0-3 M0 who had residual tumor after transurethral resections, were treated with daily intra-arterial cisplatin (5-10 mg/day total, 110-130 mg) and concurrent radiation (2 Gy/day; total, 50-60 Gy). All patients received unilateral or bilateral placement of reservoir to perform daily cisplatin infusion after alteration of intrapelvic blood flow by coil embolizations.

**Results:** A clinical complete response, defined as no viable tumor cell in the biopsy specimen, was observed in 16 (70%) patients, and a partial response was observed in 7 (30%). After a median follow-up of 72 months (range, 25-123 months), 15 patients (65%) were alive. Two cancer-related deaths were observed. Cause-specific and disease-free survival rates at 5 years were 86% and 66%, respectively. Grade3 acute toxic reactions included cystitis in one patient, leukopenia in one, and other forms of toxicity due to chemotherapy, including neuropathy in two patients were tolerable. The regimen was well tolerated, with no severe systemic or local toxicities.

**Conclusions:** The high rates of response and survival observed indicate that this combined intra-arterial chemotherapy and radiotherapy regimen would be useful in the management of invasive bladder carcinoma.

**Key words:** Bladder cancer, Bladder conserving treatment, Intra-arterial chemotherapy, Radiotherapy

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## 限局性前立腺癌に対する三次元原体照射法における 至適照射体位に関する研究

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### A STUDY OF THE OPTIMAL TREATMENT POSITIONING IN THE TREATMENT OF PROSTATE CANCER WITH THREE-DIMENSIONAL CONFORMAL RADIOTHERAPY

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**Abstract:** During external irradiation for the prostate cancer, the doses those exceed the tolerance level of the adjacent rectum or bladder are often delivered. Therefore, efforts are made to reduce the volume of these organs within the high-dose region. For example, some have tried to reduce the rectal volume within the radiation fields by controlling the fullness of the rectum and bladder, optimizing beam arrangement, and placing the patient in prone position in the hope of anterior displacement of the prostate. However, the evidence favoring prone positioning is far from conclusive. Moreover, prone position may tend to be less reproducible, thereby impairing accurate dose delivery. Therefore, prone position should be required larger safety margin than supine position theoretically. We evaluated a group of 17 patients with localized prostate cancer who underwent planning for three-dimensional conformal radiotherapy (3D-CRT) in supine and prone positions taking geometric uncertainty into consideration. In the case of identical safety margin size for both treatment positions, prone position is associated with significant reduction of the dose to rectum in the high-dose region. However, adding more 1mm to safety margin size in the prone position, the significant reduction of the dose to rectum compared to the supine position does not observed. This indicates that the increased separation of the rectum and the prostate in the prone position might be offset by geometric uncertainty. Prone position of prostate cancer patients undergoing 3D-CRT, therefore, cannot be uncritically accepted as superior to supine position.

Key words: Prostate cancer, 3D-CRT, Prone position

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## 原発不明扁平上皮癌頸部リンパ節転移に対する放射線治療

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## RADIOTHERAPY FOR CERVICAL LYMPH NODE METASTASES OF PRIMARY UNKNOWN SQUAMOUS CELL CARCINOMA

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**Abstract:** Purpose: To study therapeutic results (especially probabilities of neck control and primary site control) of radiation therapy of cervical lymph node metastases of primary unknown squamous cell carcinoma. Materials and Methods: Twenty patients with cervical lymph node metastases of primary unknown squamous cell carcinoma who received radiotherapy with or without surgery were reviewed. The involved lymph node levels were level I in 5 patients, level II in 14, level III in 5, level IV in 3, and level V in 1. There were 4 patients staged N1, 6 staged N2a, 6 staged N2b, 2 staged N2c, and 2 staged N3. Radical neck dissection was performed in 8 patients, and tumor excision in 4 patients. Seven patients received only partial excision or biopsy, and the detail for one patient was unknown. All patients were irradiated to both sides of the neck and potential primary sites. Median follow up time was 40 months (ranged from 7 to 108 months).

Results: The probabilities of three-year overall survival, progression free survival, neck control and potential primary site control were 81.9%, 69.1%, 84.1% and 93.3%, respectively. Five patients recurred at cervical lymph nodes within radiation field. Adverse prognostic factors for neck control were metastases in multiple lymph node levels, N-stage N2b, and overall treatment time over 49 days. The former two were also adverse prognostic factors for survival. Five primary tumors were diagnosed subsequently in the head and neck area. Four of them occurred within radiation field, which were at base of tongue, tonsil, nasopharynx and hypopharynx. One occurred out of field at hard palate. Distant metastasis was observed in 3 patients. As for acute toxicities there were dermatitis (Grade 3) in 3 patients and oral mucositis (over Grade 2) in 2. As for late toxicities there were xerostomia in 9 patients, skin fibrosis in 5, hypothyroidism in 5, and hypogeusia in 4. Conclusions: Clinical N stage N2b or metastases in multiple lymph node levels were risk factors for neck recurrence, even after radical neck dissection and post operative radiotherapy. Further aggressive treatment strategy such as chemotherapy should be considered for the high risk cases.

Key words: Head and neck cancer, Cervical lymph node metastasis, Primary unknown, Radiotherapy

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