ORIGINAL CONTRIBUTION

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食道癌に対するT字照射における画一的線量分布補正
―重複照射野法（field within a field technique）の応用―

村上龍次[*1]，菅原丈志[*1]，馬場祐之[*2]，山下康行[*2]

UNIFORM DOSE COMPENSATION USING FIELD WITHIN A FIELD TECHNIQUE IN T-SHAPED IRRADIATION FOR ESOPHAGEAL CANCER

Ryuji MURAKAMI[*1], Takeshi SUGAHARA[*1], Yuji BABA[*2], Yasuyuki YAMASHITA[*2]

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Abstract: Purpose: We devised a uniform compensation method to improve dose distribution using the field within a field technique in T-shaped irradiation for esophageal cancer.
Material and Method: Isodose curves and dose volume histograms (DVH) of the esophagus in the treatment volume were examined in ten patients treated for esophageal cancers. For the DVH analysis, the prescription dose was 40 Gy to the center of the treatment volume, and the volume ratio of the esophagus receiving within ±5% of the prescription dose (38-42Gy) was regarded as an index of dose homogeneity (V±5%).
Result: The peak dose in the conventional antero-posterior opposed fields irradiation existed at the clavicular level, and the 90% isodose curve crossing the esophagus almost corresponded to the top level of the aortic arch. When 40 Gy is irradiated, the maximum dose of the esophagus and V±5% were 45.55±0.55 Gy and 59.7± 13.2% respectively. The dose distribution of the esophagus became relatively homogeneous when a 10% dose was added using the field within a field technique to the area under the bottom level of the aortic arch, and the maximum dose and V±5% were 42.53±0.94 Gy and 91.7±7.1% respectively.
Conclusion: A 10% and more overdose area existed at the clavicular level in the conventional antero-posterior opposed fields irradiation. A relatively homogeneous dose distribution could be obtained using the field within a field technique.

Key words: Esophageal cancer, Radiotherapy, Dose compensation, Field within a field technique

要旨：【目的】食道癌に対するT字照射において，重複照射野法（field within a field technique）を応用し，画一的な線量分布補正を試みた．
【方法】実際にT字照射を行った10例において，等線量曲線および照射体積内の食道の線量体積ヒストグラム（DVH）を検討した．DVHの評価では，照射体積中心に照射線量を40 Gyとし，±5%以内の線量（38～42 Gy）となる食道の体積比を線量均一性の指標とした．
【結果】通常の前後対向2門照射における線量のピーク（100%）は，鎖骨レベルに存在し，食道に重なる90%等線量曲線は大動脈弓部上縁レベルにほぼ一致していた．40 Gyの照射を考慮したとき，食道の最大線量は45.55±0.55 Gyであり，線量均一性は59.7±13.2%であった．大動脈弓部下縁以下の重複照射野で10%の線量を補充すると食道の線量は均一化し，最大線量42.53±0.94 Gy，線量均一性91.7±7.1%に改善した．
【結語】通常のT字照射では鎖骨レベルに10%以上の過線量域が存在していた．大動脈弓部下縁以下への重複照射野で10%線量の画一的な補充によって，線量均一化が得られた．

[*1] 熊本赤十字病院放射線科（〒862-8520 熊本県熊本市長嶺南2-1-1）
Department of Radiology, Japanese Red Cross Kumamoto Hospital（2-1-1, Nagamineminami, Kumamoto, 862-8520 JAPN）
[*2] 熊本大学医学部放射線科
Department of Radiology, Kumamoto University School of Medicine

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Segmental multileaf collimator（SMLC)-IMRTにおける線量照合と評価 —第一報：線量分布—

舘岡 邦彦[*1, *2]，大内 敦[*3]，長瀬 大輝[*2]，和歌 正明[*4]，才川 恒彦[*2]，
清水目 一成[*2]，杉本 晴美[*2]，中田 健生[*3]，晴山 雅人[*1, *2, *3]

DOSIMETRIC VERIFICATION AND EVALUATION OF SEGMENTAL MULTILEAF COLLIMATOR (SMLC)-IMRT FOR QUALITY ASSURANCE —THE FIRST REPORT: DOSE DISTRIBUTIONS—

Kunihiko TATEOKA[*1, *2], Atsushi OOUCHI[*3], Daiki NAGASE[*2], Masaaki WAKA[*4],
Tsunehiko SAIKAWA[*2], Kazunari SHIMIZUME[*2], Harumi SUGIMOTO[*2],
Kensei NAKATA[*3], Masato HAREYAMA[*1, *2, *3]

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Abstract: Intensity-modulated radiation therapy (IMRT) was developed to irradiate the target are more conformally, sparing organs at risk (OARs). Since the beams are sequentially delivered by many, small, irregular, and off-center fields in IMRT, dosimetric quality assurance (QA) is an extremely important issue. QA is performed by verification of both the dose distribution and doses at some arbitrary points. This paper reports verification of dose distribution in our hospital for Segmental multileaf collimator (SMLC)-IMRT

The calculated dose distribution was compared with that acquired by film measurements. In film dosimetry, we used two kinds of the radiographic film (Kodak X-OmatV and EDR2) and Tough Water (Kyoto Kagaku Co. Ltd) as a water equivalent phantom and the dose distribution calculated of any plane by using a FOCUS (CMS Co. Ltd) Radiation Treatment Planning System (RTP). In general, film dosimetry is a method for obtaining the relative dose distribution, because the film sensitivity changes variably with the distribution of photon energy corresponding to the field size and set-up depth of the film in a phantom.
We studied the physical characteristics and properties of these two different films. X-OmatV film showed higher dose values as the irradiated volume increased in a phantom but EDR2 film was seldom affected by scattering volume. Therefore we decided to use EDR2 for verification of dose distributions for intensity-modulated beams rather than X-OmatV.

The film method is not widely accepted for absolute dosimetry, but we thought that it might be able to be used for absolute point-dose verification with EDR2. To verify three-dimensional (transverse, coronal, sagital) dose distributions, some radiographic films put between layers of Tough Water were irradiated and the corresponding calculated dose distributions were obtained with RTP with using CT images of the same phantom. The two-set isodose curves on the dose distribution keep almost the same shape and they had good agreement in high regions of the dose gradients. In low regions of the dose gradients of the phantom, the doses differences were within about 3%.

This difference between the paired set-dose profiles were about 20 cGy on and the deviation distance was about 1.5 mm. The discrepancy in high regions of the dose gradients may be affected by the geometrical accuracy of the MLC leaves movements. If errors of MLC leaves position are about 1.5 mm, the according output change is within about ±0.1%. We supposed that dose distributions were not significantly influenced by the deviation of output due to the accuracy of the MLC leaves positions.

Key words: Intensity-modulated radiation therapy, Dosimetry, Quality assurance, Film dosimetry

[*1] 札幌医科大学大学院医学研究科　分子・器官制御医学専攻—分子・器官制御医学領域—放射線治療診断学
（〒060-8543 札幌市中央区南一条西16丁目291）
Radiation Oncology, Imaging and diagnosis, Molecular and Organ Regulation, Sapporo Medical University Graduate School of Medicine
（291, Nishi 16-chome, Minami-ihcijo, Chuo-ku, Sapporo, 060-8543 JAPAN）
[*2] 札幌医科大学医学部附属病院放射線部
Division of Radiology and Nuclear Medicine, Sapporo Medical University Hospital School of Medicine
[*3] 札幌医科大学医学部放射線医学講座
Department of Radiology, Sapporo Medical University
[*4] 札幌医科大学教育研究機器センターラジオアイソトープ研究部門
Department of Radioisotope Research, Biomedical Research, Education and Instrumentation center, Sapporo Medical University

要旨：強度変調放射線治療（intensity modulated radiation therapy：以下，IMRT）が開発され，腫瘍への一層の線量集中と腫瘍周辺のリスク臓器や正常組織の温存を図れるようになった．しかし不整形照射野を連続して照射するため，線量の品質保証（Quality Assurance）の重要性が強調されている．当院ではSegmental multileaf collimator IMRTを行っている．その際の線量検証における線量分布の照合方法を中心に報告し検討を加えた．

線量分布の検証に用いるフィルムの物理特性を明確にした．X-OmatVフィルムは照射容積が大きくなるとフィルム線量が増加することが判明した．一方，EDR2フィルムはほぼ絶対線量の評価が可能であると思われた．三次元的な検証をするために，固体ファントムに複数のフィルムを挟んで絶対線量で検討を行った．線量分布は高線量域においてよく一致し，低線量域においても治療計画装置に対して約3%以内の相違であった．また，線量プロファイルは線量の急勾配領域で約20 cGyの相違を示したが，同じ線量を与える軸外距離の差は約1.5 mm以内であった．この誤差は，Multi Leaf Collimator（以下，MLC）の位置精度によるものと思われる．しかし，この精度による出力の変動は約±0.1%以下であり，線量分布上に有意な影響がないと思われる．

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Segmental multileaf collimator（SMLC)-IMRTにおける線量照合と評価 ―第2報：絶対線量―

舘岡 邦彦[*1, *2]，大内 敦[*3]，長瀬 大輝[*2]，和歌 正明[*4]，才川 恒彦[*2]，
清水目 一成[*2]，杉本 晴美[*2]，中田 健生[*3]，晴山 雅人[*1, *2, *3]

DOSIMETRIC VERIFICATION AND EVALUATION OF SEGMENTAL MULTILEAF COLLIMATOR (SMLC)-IMRT FOR QUALITY ASSURANCE —THE SECOND REPORT: ABSOLUTE DOSE—

Kunihiko TATEOKA[*1, *2], Atsushi OOUCHI[*3], Daiki NAGASE[*2], Masaaki WAKA[*4],
Tsunehiko SAIKAWA[*2], Kazunari SHIMIZUME[*2], Harumi SUGIMOTO[*2],
Kensei NAKATA[*3], Masato HAREYAMA[*1, *2, *3]

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Abstract: Intensity-modulated radiation therapy (IMRT) was developed to irradiate the target are more conformally, sparing organs at risk (OARs). Since the beams are sequentially delivered by many, small, irregular, and off-center fields in IMRT, dosimetric quality assurance (QA) is an extremely important issue. QA is performed by verifying both the dose distribution and doses at arbitrary points. In this work, we describe the verification of doses at arbitrary points in our hospital for Segmental multileaf collimator (SMLC)-IMRT.

In general, verification of the absolute doses for IMRT is performed by comparison between the calculated doses using Radiation Treatment Planning Systems (RTP) and the measured doses using an ionization chamber with a small volume at arbitrary points in relatively flat regions of the dose gradients.

However, no clear definitions of the dose gradients and the flat regions have yet been reported.

We carried out verification by comparison of the measured doses with the average dose and the central point dose in a virtual Farmer type ionization chamber (V-F) and a virtual PinPoint ionization chamber (V-P) equal to the Farmer-type ionization chamber volume and PinPoint ionization chamber volumes using the RTP. Furthermore, we defined the dose gradients as the deviation of the maximum dose from the minimum dose in the virtual ionization chamber volume.

In IMRT, the dose gradients may be as high as 80% or more in the virtual ionization chamber volume. Therefore, it is thought that the effective center of the ionization chamber varies by segment for IMRT fields (i.e, the variation of the ionization chamber replacement effect). Additionally, in regions with a higher dose gradient, uncertainty in the measured doses is influenced by the variations in the ionization chamber replacement effect and the ionization chamber positioning error.

We more objectively examined the verification method for the absolute dose in IMRT using the virtual ionization chamber volume, taking account of the variations in the ionization chamber replacement effect and the ionization chamber positioning error.

Deviations of the central point dose and the average dose calculated in the V-F and a V-P were about 8% and 2%, respectively, in regions with a high dose gradient, and about 3% and 1%, respectively, in regions with a low dose gradient. Therefore, when the accuracy of the beam commissioning of the RTP, point of measurement for the ionization chamber and the deviation of the geometry of MLC leaves are considered, it was thought that the average dose derived from the RTP should be used for comparisons of measured doses.

If the average dose and dose gradient of ±2mm were used for a measurement point, verification of the absolute dose was possible within about 3% in regions where the dose gradient was less 10%, and within ± 2mm in regions where dose gradient was over 10%.

Furthermore, it was demonstrated that the output factor algorithm we developed made possible useful dose calculation independent of the RTP.

Key words: Intensity-modulated radiation therapy, Dosimetry, Quality assurance, Absolute dose

[*1] 札幌医科大学大学院医学研究科　分子・器官制御医学専攻―分子・器官制御医学領域―放射線治療診断学
（〒060-8543 札幌市中央区南一条西16丁目291）
Radiation Oncology, Imaging and diagnosis, Molecular and Organ Regulation, Sapporo Medical University Graduate School of Medicine
（291, Nishi 16-chome, Minami-ihcijo, Chuo-ku, Sapporo, 060-8543 JAPAN）
[*2] 札幌医科大学医学部附属病院放射線部
Division of Radiology and Nuclear Medicine, Sapporo Medical University Hospital School of Medicine
[*3] 札幌医科大学医学部放射線医学講座
Department of Radiology, Sapporo Medical University
[*4] 札幌医科大学教育研究機器センターラジオアイソトープ研究部門
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IMRTにおける絶対線量は線量勾配の平坦な領域内の任意の点で電離容積の小さい電離箱を用いた実測値とRTPの計算値との比較で検証されている．しかし，線量勾配の定義のみならず平坦な領域の定義は論文的にも明らかではない．
我々は電離箱と同じ容積（仮想電離箱）内における平均線量および中心点線量をRTPで算出し実測値と比較し検証を行った．さらに，線量勾配を仮想電離箱容積内における最大線量に対する最小線量の相違と定義した．IMRTでは，我々が示したように線量勾配は仮想電離箱容積内においてさえ80%以上になる場合があり，実効中心はセグメント毎に電離箱容積内で変動していると考えられる．さらに，線量勾配が大きい領域では電離箱の設置位置および置換効果の変動が大きく影響を受け電離箱の実測値には不確実性が存在する．我々はこれらの不確実性を考慮しより客観的な評価法を検討した．
RTPで算出される中心点線量と平均線量の相違は線量勾配が少ない領域においてFarmer型電離箱およびPinPoint電離箱で各々約3%，1%，勾配が大きい領域では各々約8%，2%であったが，線量勾配，電離箱の設置位置，MLCのleaf開度等の幾何学的変位およびRTPのビームコミッショニングの精度を考慮すると実測値との比較にはRTPで計算される電離箱容積内の平均線量を用いるべきと思われた．
平均線量を用い，さらに測定点から±2 mmの線量勾配を把握することで線量勾配10%以内の領域で線量として約3%以内，またこれ以上で線量勾配が大きい領域では距離として±2 mm以内での検証が可能であった．
さらに，RTPから独立した線量計算が可能な独自開発の出力係数アルゴリズムが有用な手段であることを示した．

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再発性腹部悪性腫瘍に対する息止め照射の治療経験

赤木 由紀夫[*1]，橋本 泰年[*1]，村上 祐司[*2]

THE 3-D CHEMORADIOTHERAPY EXPERIENCE OF REFRACTORY ABDOMINAL MALIGNANT TUMORS BY SELF BREATH-HOLD WITH ELECTRONIC PORTAL IMAGES

Yukio AKAGI[*1], Yasutoshi HASHIMOTO[*1], Yuji MURAKAMI[*2]

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Abstract: We have reported 3-D chemoradiotherapy experience of refractory abdominal malignant tumors. From April 2001 to Jun 2002, we treated 14 patients by self breath-hold with electronic portal images verification. This technique permits the precise delivery of a high dose of radiation to the target while sparing most of adjacent normal organs. Response rates and clinical benefit response were 64% and 80%, respectively. Two patients are cancer free, 3 patients died with cancer and 9 patients live with cancer but are outpatients. Two patients have hade late gastrointestinal complications, 1 patient received a bypass-operation due to radiation-induced pylorus stricture, and the other patient has had H2-blocker and Proton-Pump-Inhibitor due to a radiation-induced gastric ulcer. Otherwise, we believe these results endorse the validity of 3D-chemoradiotherapy by self breath-hold with electric portal images. An optimal treatment schedule should be established by further investigation.

Key words: 3-D chemoradiotherapy (3D-CRT), Self breath-hold, Refractory abdominal malignant tumors

要旨：前治療が無効であった腹部悪性腫瘍14例に対し、化学療法同時併用の息止め照射を施行した。治療計画は5 mm厚/5 mm幅で撮影したCTをもとに、FOCUS3Dで行った。照射野の3Dマージンの設定はPTV-GTV=5ないし10 mmとし、処方線量は線量評価点をアイソセンタとして60 Gy/20回/4週とした。腫瘍辺縁線量が線量評価点の90%以上にことを原則とした。治療装置は10 MVマイクロトロンX線を用い、6例に固定多門照射、8例にダイナミック原体照射法を用いた。治療直前にPortal Imageにて照射位置を、治療中に監視カメラで体表面の照射マーカとレーザマーカの目視確認を行った。息止め補助のため、酸素マスクで3 L/分の酸素吸入を行った。奏効率は64%で、症状改善率は80%であった。有害事象としては幽門狭窄と難治性胃潰瘍が、それぞれ1例認められた。本法は腹部悪性腫瘍に対して、有効かつ安全な救済治療であると思われた。

[*1] 広島市立安佐市民病院放射線科（〒731-0293 広島市安佐北区可部南2-1-1）
Department of Radiology, Hiroshima Asa City Hospital（2-1-1, Kabeminami, Asakita-ku, Hiroshima, 731-0293 JAPAN）
[*2] 広島大学医学部放射線医学教室
Department of Radiology, Hiroshima University School of Medicine

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子宮頸癌に対する中線量率腔内照射

田中 英一[*1], 礒橋 文明[*2], 呉 隆進[*2], 山田 優二[*2], 島本 茂利[*2], 中村 聡明[*2],
塩見 浩也[*2], 手島 昭樹[*3], 井上 武宏[*2], 井上 俊彦[*2]

MEDIUM-DOSE-RATE INTRACAVITARY BRACHYTHERAPY FOR CERVICAL CANCER

Eiichi TANAKA[*1], Fumiaki ISOHASHI[*2], Ryoong-Jin OH[*2], Yuji YAMADA[*2], Shigetoshi SHIMAMOTO[*2],
Satoaki NAKAMURA[*2], Hiroya SHIOMI[*2], Teruki TESHIMA[*3], Takehiro INOUE[*2], Toshihiko INOUE[*2]

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Abstract: Purpose: To evaluate the results of medium-dose-rate (MDR) intracavitary brachytherapy (ICRT) for cervical cancer.

Materials and Methods: Between May 1991 and March 2001, 80 patients with cervical cancer were treated with external radiotherapy combined with MDR-ICRT. Two patients were excluded from this study. The median age of patients was 61 years (range: 30-87 years). Seventy-five patients had pathologically proved squamous cell carcinoma, and 3 had adenocarcinoma. The patients were staged by UICC classification as follows: Stage IA (2), Stage IB (4), Stage IIA (5), Stage IIB (22), Stage IIIA (1), Stage IIIB (32), Stage IVA (5), Stage IVB (7). Median follow-up for survivor was 68 months (range: 12-131 months).

The radiation therapy was based on a combination of ICRT and external pelvic irradiation. Patients with stages II, III and IVA were treated with whole-pelvic irradiation with respective total doses of 20, 30, and 40 Gy. Doses of 40, 30, 20, and 20 Gy parametrial irradiation were added with central shield pelvic irradiation for stages IB, II, III and IVA lesions respectively. For MDR-ICRT, from May 1991 to December 1995, point A dose were 40 Gy/4 fractions for stages I and II, 38 Gy/4 fractions for stage III, and 28.5 Gy/3 fractions for stage IVA. And from January 1996 to March 2001, point A dose of 36 Gy/4 fractions for stages I and II, 34 Gy/4 fractions for stage III, and 25.5 Gy/3 fractions for stage IVA. The median dose rate at point A was 1.7 Gy/hour (range: 1.3-2.2 Gy/hour).

Results: The 5-year cause-specific survival rates were 100%, 76%, 51% and 40% for stages I, II, III and IVA respectively. All patients with stage IVB died from the tumor with a median survival time of 12 months. The 5-year pelvic control rates were 100%, 88%, 69% and 40% for stages I, II, III and IVA respectively.

Major late complications occurred in 2 patients (3%). One patient developed vesico- and recto-vaginal fistulae, and died of pelvic infection due to pelvic necrosis without local recurrence 6 years after radiotherapy (Grade 5). Another patient developed perforation of sigmoid colon 9 years after radiotherapy (Grade 4). Minor late complications (Grade 1-2) occurred in 7 patients (9%).

Conclusion: MDR-ICRT for cervical cancer can be used as effectively as low-dose-late (LDR) and high-dose-rate (HDR) ICRT.

Key words: Cervical cancer, Intracavitary brachytherapy, Medium-dose-rate (MDR)

[*1] 大阪大学大学院医学系研究科医用制御工学（〒565-0871 大阪府吹田市山田丘2-2）
Department of Radiology, Osaka University Graduate School of Medicine（2-2, Yamada-oka, Suita, Osaka, 565-0871 JAPAN）
[*2] 同集学放射線治療学
Division of Multidisciplinary Radiotherapy, Osaka University Graduate School of Medicine
[*3] 同保健学科
Department of Medical Engineering, Osaka University Graduate School of Medicine

要旨：【目的】子宮頸癌に対する中線量率腔内照射の治療成績を検討した．
【対象と方法】1991年5月から2001年3月までに外照射と中線量率腔内照射で治療した子宮頸癌新鮮例80例のうち78例を対象とした．年齢は30～87歳（中央値61歳）であった．病期別症例数はIA期：2例，IB期：4例，IIA期：5例，IIB期：22例，IIIA期：1例，IIIB期：32例，IVA期：5例，IVB期：7例であった．扁平上皮癌75例，腺癌3例であった．生存者の経過観察期間は12～131ヶ月（中央値68ヶ月）であった．
1991年5月から1995年12月までの外照射および腔内照射線量は，IA期は腔内照射単独40 Gy/4 fx，IB期は中央遮蔽40 Gy，腔内照射40 Gy/4 fx，II期は全骨盤照射20 Gyおよび中央遮蔽30 Gy，腔内照射40 Gy/4 fx，III期は全骨盤照射30 Gyおよび中央遮蔽20 Gy，腔内照射38 Gy/4 fx，IVA期は全骨盤照射40 Gyおよび中央遮蔽20 Gy，腔内照射28.5 Gy/3 fxであった．1996年1月以後の腔内照射線量は，IA期は36 Gy/4 fx，IB期は36 Gy/4 fx，II期は36 Gy/4 fx，III期は34 Gy/4 fx，IVA期は25.5 Gy/3 fxであった．A点の線量率は1.3～2.2 Gy/時間（中央値1.7 Gy/時間）であった．
【結果】疾患特異的5年生存率はI期100%，II期76%，III期51%，IVA期40%であった．IVB期の5例は生存期間中央値12ヶ月で，すべて原病死した．5年骨盤内制御率はI期100%，II期88%，III期69%，IVA期40%であった．
重篤な晩期有害事象をIIIB期の2例（3%）に認めた．1例は，照射15ヶ月後に直腸膣瘻，18ヶ後に膀胱膣瘻を生じ，6年後に子宮周囲の壊死に伴う骨盤内感染症のため死亡した（Grade 5）．1例は照射9年後にS状結腸の穿孔をきたした（Grade 4）．これら2例については，線量分布上の問題点や開腹術の既往などの合併症は特に認めなかった．その他，Grade 1および2の晩期障害を7例（9%）に認めた．
【結論】計画した治療線量は妥当であり，中線量率腔内照射も子宮頸癌に対する有効な治療法の一つであると考えられる．

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FFT convolution/multigrid superpositionアルゴリズムにおけるエネルギースペクトル修正の最適化について

羽生 裕二[*1]，福岡 美代子[*1]，星野 君枝[*1]，大野 淳[*1]，園田 辰夫[*1]，
平林 久枝[*1]，唐澤 久美子[*3]，三橋 紀夫[*2]

THE OPTIMUM MODIFICATION OF ENERGY SPECTRA USING FFT CONVOLUTION/MULTIGRID SUPERPOSITION ALGORITHM ON THE FOCUS RADIATION TREATMENT SYSTEM

Yuji HANYU[*1], Miyoko FUKUOKA[*1], Kimie HOSHINO[*1], Atsushi ONO[*1], Tatsuo SONODA[*1],
Hisae HIRABAYASHI[*1], Kumiko KARASAWA[*3], Norio MITSUHASHI[*2]

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Abstract: In the convolution/superposition algorithm, the energy spectrum should be modified to make the reconstructed dose distribution consistent with the measured dose distribution. The energy spectrum, which gives the best agreement, is not determined uniquely depending on the reconstruction procedure.

In this report, the effects of the characteristics of the energy spectrum on the calculation accuracy are evaluated by comparing the PDD and beam profiles for the reference energy spectrum with those calculated for the modified spectrum in order to optimize the energy spectrum modification procedure when 4 and 10 MV X-ray beams are used.

Decreasing the number of energy bins brought a larger decrease rate in the computation accuracy than a decrease rate in computation time. Further, the decrease of the number of energy bins led to a change of the energy spectrum. The balance of the relative fluence weight in a each bin and its average energy, which determines the absoluted dose, are important parameters. Three percent changes in the average energy spectra should be made to realize maximum a change in PDD of 1%. This suggests that the spectrum which gives the result with a maximum error in PDD of within 1%, does not only exist if the balance of the relative fluence weight in each bin is kept similar to the reference spectrum and the average energy changes are kept within 3%.

Consequently, more than one suitable spectra to make the calculated PDD consistent with the measured dose distributions with a maximum error in PDD of within 1%, exists when the relative photon fluence of a spectrum in each bin is varied by keeping the balance of the relative fluence weight in each bin and the range of the average energy of the spectrum similar to the reference.

Key words: Superposition, TERMA, Kernel, RTPS

要旨：convolution/superpositionアルゴリズムにおいては，実測線量分布に計算線量分布を一致させるようにエネルギースペクトルを修正していく作業が必要である．しかしながら，この過程において最良の一致を引き出すエネルギースペクトルは修正過程の作業方法によって一意的に決まらない．

そこで，本報告ではエネルギースペクトル修正作業の最適化のため，4 MVと10 MV X線を対象として基準エネルギースペクトルによるPDD，ビームプロファイルと，変更したエネルギースペクトルによるその計算値を比較することでエネルギースペクトル特性とその計算精度について評価した．

energy bin数の減少は，計算精度低下に対する計算時間短縮効率が悪く実用的ではない．さらに，energy bin数の減少はエネルギースペクトルの変化につながる．binごとの加重比率とともにその平均エネルギーは吸収線量を左右する重要な代表値であり，PDDに最大変化量1%をもたらすためにはエネルギースペクトル平均エネルギー3%の変更が必要である．これは，基準エネルギースペクトルに対して，binごとの加重比率をほぼ維持し，さらにその平均エネルギー変化が3%以内に保たれていれば，PDD最大誤差1%以内の計算結果を導くエネルギースペクトルは一意的に決まらないことを意味している．

したがって，実測値に対してPDD最大誤差1%以内の計算結果を導く最適なエネルギースペクトルは，binごとの加重比率，ならびにスペクトル平均エネルギー範囲を維持し，energy binの相対光子フルエンスを変更していくならば，ひとつには限らない．

*1東京女子医科大学病院放射線腫瘍部（〒162-8666 東京都新宿区河田町8-1）
Division of Radiology, Tokyo Women's Medical University Hospital（8-1, Kawada-cho, Shinjuku-ku, Tokyo 182-8666 JAPAN）
*2東京女子医科大学放射線医学教室
Department of Radiology, Tokyo Women's Medical University, School of Medicine
*3順天堂大学医学部放射線医学教室
Department of Radiology, Juntendo University, School of Medicine

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COMPARISON OF TREATMENT TECHNIQUES OF STEREOTACTICALLY-GUIDED CONFORMAL TREATMENT USING A MICRO-MULITILEAF COLLIMATOR

Yasushi HAMAMOTO[*1], Keiji NIINO[*2], Hiromichi ISHIYAMA[*2], Takaaki HOSOYA[*2]

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Abstract: The treatment techniques of stereotactically-guided conformal treatment using a micro-multileaf collimator were compared with respect to varying shapes or volume of the planning target volumes (PTV) for 35 clinically treated lesions (classification of shapes; nearly spherical PTV, 17; non-spherical PTV, 18: classification of size; <10 ml, 25; > or =10 ml, 10). Non-coplanar 4-, 6-, 8 static conformal beam technique and 3-, 5- 9 dynamic arc treatment (the rotation angle of each arc is 100 degrees) were compared with respect to normal tissue volume irradiated highly or moderately, conformity of the prescription isodose surface, and dose homogeneity within the PTV. Non-targeted normal tissue volume receiving 80%, 60%, and 40% dose of the prescribed dose tended to decrease by increasing the number of fields in 4-8 SCB, and statistically significant improvements were observed between 3 DA and 5 DA, regardless of PTV shapes or volume. The conformity of the prescription isodose surface was improved between 4 SCB and 6 SCB, and 3 DA and 5 DA with statistical significance, regardless of PTV shapes or volume. The improvements of conformity indices were larger especially in the non-spherical PTV or the large PTV. Satisfying dose homogeneity was achieved by all assessed treatment techniques. SCB with 6-8 fields may be adequate for the treatment of the nearly spherical PTV, and DA with around 5 arcs may be suitable for the treatment of the irregular and/or large PTV. Adding further arcs to 5 DA did not bring a further significant benefit, regardless of PTV shapes or volume.

Key words: Stereotactically-guided conformal treatment, Micro-multileaf collimator, Non-coplanar conformal beam technique, Dynamic arc technique

要旨：マイクロマルチリーフコリメータを用いた定位原体照射の照射法についてplanning target volume（PTV）の形状や体積を考慮しながら比較した．対象は実際に定位照射を施行した35病巣（形状による分類では類球形：非球形=17：18，体積による分類では10 ml未満：10 ml以上=25：10）である．これらについて，固定4，6，8門照射，3，5，9軌道原体照射（1軌道の回転角100度）の治療計画を作成し，80%，60%，40%線量域に含まれる正常組織体積，treated volumeのconformity，PTV内の線量均一性について比較した．80%，60%，40%線量域内の正常組織体積はPTVの形状や体積によらず，固定4，6，8門照射の間では門数を増やすと減少傾向を示し，3軌道と5軌道原体照射の間ではPTVの形状や体積によらず，統計学的に有意な改善が得られた．conformityは形状，体積によらず，4門と6門，3軌道と5軌道の間で統計学的に有意な改善を示した．conformityの改善は類球形PTVと非球形PTVを比較すると，非球形でより大きかった．PTV内の線量均一性については照射法による明らかな違いはみられなかった．類球形PTVに対しては固定6〜8門照射を用いても問題ないと考えられたが，非球形PTV，体積の大きなPTVに対しては，5軌道程度（総回転角500度程度程度）の回転原体照射が適すると考えられた．また，回転原体照射において，5軌道よりも軌道数を増やしても明らかな改善はないと考えられた．

マイクロマルチリーフコリメータを用いた定位原体照射における照射法の比較
濱本 泰[*1]，新野 恵司[*2]，石山 博條[*2]，細矢 貴亮[*2]
[*1] 国立病院四国がんセンター放射線科（〒790-0007 愛媛県松山市堀之内13）
Department of Radiology, National Shikoku Cancer Center（13, Horinouchi, Matsuyama City, Ehime, 790-0007 JAPAN）
[*2] 山形大学医学部放射線科
Department of Radiology, Yamagata University School of Medicine

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頭頸部再発癌に対しCyberKnifeを用いた再照射の初期治療経験

姫井 健吾[*1]，勝井 邦彰[*1]，吉田 敦史[*1]，武本 充広[*1]，黒田 昌宏[*1]，金澤 右[*2]，
佐藤 健吾[*3]，馬場 義美[*3]，大森 理江[*4]，井上 光広[*4]，平木 祥夫[*2]

INITIAL RESULTS OF CYBERKNIFE TREATMENT FOR RECURRENT PREVIOUSLY IRRADIATED HEAD AND NECK CANCER

Kengo HIMEI[*1], Kuniaki KATSUI[*1], Atsushi YOSHIDA[*1], Mitsuhiro TAKEMOTO[*1],
Masahiro KURODA[*1], Susumu KANAZAWA[*2], Kengo SATO[*3], Yoshimi BABA[*3],
Rie OMORI[*4], Mitsuhiro INOUE[*4], Yoshio HIRAKI[*2]

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Abstract: Purpose: To evaluate the efficacy of CyberKnife for recurrent previously irradiated head and neck cancer.
Materials and Methods: Thirty-one patients with recurrent previously irradiated head and neck cancer were treated with a CyberKnife from July 1999 to March 2002 at Okayama Kyokuto Hospital were retrospectively studied. The accumulated dose was 28-80 Gy (median 60 Gy). The interval between CyberKnife treatment and previous radiotherapy was 0.4-429.5 months (median 16.3 months). Primary lesions were nasopharynx: 7, maxillary sinus: 6, tongue: 5, ethmoid sinus: 3, and others: 1. The pathology was squamous cell carcinoma: 25, adenoid cystic carcinoma: 4, and others: 2. Symptoms were pain: 8, and nasal bleeding: 2. The prescribed dose was 15.0-40.3 Gy (median 32.3 Gy) as for the marginal dose.
Results: The response rate (CR+PR) and local control rate (CR+PR+NC) was 74% and 94% respectively. Pain disappeared for 4 cases, relief was obtained for 4 cases and no change for 2 cases and nasal bleeding disappeared for 2 cases for an improvement of symptoms. An adverse effects were observed as mucositis in 5 cases and neck swelling in one case.
Conclusions: Prognosis of recurrent previously irradiated head and neck cancer was estimated as poor. Our early experience shows that CyberKnife is expected to be feasible treatment for recurrent previously irradiated head and neck cancer, and for the reduction adverse effects and maintenance of useful QOL for patients.

Key words: Recurrent head and neck cancer, CyberKnife, Reirrardiation, Stereotactic irradiation

要旨：平成11年7月から平成14年3月までに放射線治療歴のある頭頸部再発癌31例に対し岡山旭東病院でCyberKnifeを用いて治療を施行した．累積線量は28～80 Gy（中央値60 Gy）であった．今回の再治療に至までの期間は0.4～429.5ヶ月（中央値16.3ヶ月）であった．原発巣は上咽頭癌：7例，上顎洞癌：6例，舌癌：5例，篩骨洞癌：3例，その他：9例であった．病理組織は扁平上皮癌：25例，腺様嚢胞癌：4例，その他：2例であった．自覚症状は疼痛を8例，鼻出血を2例で認めた．分割回数は1～6分割（1分割：3例，2分割：1例，3分割：7例，5分割：18例，6分割：2例）を用いた．PTVは2.6～381.0 cm^3（中央値41.2 cm^3）であり，投与線量はDVHを用いPTVの90%を囲む辺縁線量で評価し，総線量15.0～40.3 Gy（中央値32.3 Gy）であった．治療後の一次効果，症状の改善程度，急性有害反応，転帰について検討した．治療後の一次効果は奏功率（CR+PR）は74%，局所コンロトール率（CR+PR+NC）は94%であった．症状の改善については疼痛が8例中4例で消失，4例で軽減，2例で不変であり，鼻出血が2例で消失した．急性有害反応は粘膜炎を5例，頸部腫脹1例を認め保存的治療を行った．転帰については生存が13例，原病死が14例，他病死が4例であった．原病死のうち治療部位の制御例は7例，非制御例は7例であった．再発した場合の治療方法の選択に苦慮することが多く，また予後不良と考えられる放射線治療の既往歴のある頭頸部再発癌に対しQOLを保ちながら短期間での局所治療が可能であり，症例のよっては有用な治療方法になると考えられた．

[*1] 岡山大学医学部放射線科（〒700-8558 岡山市鹿田町2-5-1）
Department of Radiology, Okayama University Medical School（2-5-1, Shikata-cho, Okayama, 700-8558 JAPAN）
[*2] 岡山大学大学院医歯学総合研究科放射線医学分野
Okayama University Graduate School of Medical and Dentistry Radiology
[*3] 岡山旭東病院　脳神経外科
Department of Neurosurgery, Okayama Kyokuto Hospital
[*4] 岡山旭東病院　放射線課
Division of Radiology, Okayama Kyokuto Hospital

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RETROSPECTIVE STUDY OF TREATMENT RESULTS FOR LIMITED-STAGE SMALL -CELL LUNG CANCER IN NATIONAL NISHIGUNMA HOSPITAL

Yoshizumi KITAMOTO[*1, *2], Yuko NAKAYAMA[*1], Masana MATSUURA[*2], Takashi NAKANO[*1], Satoshi TSUCHIYA[*3], Ryusei SAITO[*3], Kazushige HAYAKAWA[*4], Hideo NIIBE[*1]

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Abstract: Purpose: We retrospectively evaluated the treatment results of limited-stage small cell lung cancer (LS-SCLC) in National Nishigunma Hospital and indicated some problems when standard of radiation therapy for LS-SCLC was put into practice in our hospital.
Materials and methods: From February 1984 to October 2000, 49 patients were newly diagnosed with LS-SCLC in National Nishigunma Hospital. All cases were confirmed as small-cell carcinoma by the histologic and cytologic findings. Patients consisted of 39 males and 10 females, the ages ranged from 46 to 87 years (mean, 66 years), Patients ≧75 years were 16%. There were 41 (84%) patients in Eastern Cooperative Oncology Group performance status (PS) 0 or 1 and 8 (16%) were in PS 2 or 3. All patients were treated with chemoradiotherapy. For thoracic radiation therapy (TRT), conventional once daily fractionation of 2.0 Gy was employed in principle, five patients were treated on a twice-daily schedule, and the average total doses were 48 Gy (30-60 Gy). In chemotherapy, all were treated with chemotherapy of various contents. For the first several years of this series, cyclophosphamide based chemotherapy and platinum based chemotherapy were mixed, but 41 of 49 patients were treated with platinum based chemotherapy from the late 1980s. The numbers of patients treated by concurrent and sequential chemoradiotherapy were 21 and 28, respectively. During this period, radiotherapy staff were insufficient. Part-time radiation oncologists treated patients twice a week with one or two radiotherapists by June in 1997. From July 1997, one full-time and another part-time radiation oncologists worked with the two radiotherapists.
Results: The median survival of the 49 patients was 22 months. The 2- and 5-year overall survival rates were 45% and 18%, respectively, and the 2- and 5- year cause specific survival rates were 51% and 20%, respectively. The 2- and 5-year disease free survival rates were 23% and 15%, respectively. The local and/or distant failure appeared in 80% of patients who could be confirmed. The initial failure site was within the radiation field in 26% patients, the brain in 15%, and 39% of the patients had tumor progression only outside the radiation field or both in-field and distant failures at the same time. Of the patients with a recurrence, 92% were detected within 20 months after treatment and recurrent lesions appeared in the last patients 48 months after treatment. Six patients (12%) had survived free of disease beyond 5 years. Only PS was statistically significant to cause specific survival rate by the log-rank test.
Conclusions: Our treatment results were reasonable as a historical report. It is said that the most appropriate treatment for patients with LS-SCLC in good condition at this time is concurrent chemotherapy and TRT by accelerated hyperfractionated radiation therapy and PCI for complete responders. However we should be careful to apply these methods to patients of a middle-sized hospital in Japan because it is possible that there are some patients who have poor risk factors of survival or toxicities in non-selective patients. Another problem is that twice-daily radiotherapy could be a burden to radiotherapy staff because of an insufficiency of radiation oncologists and radiation therapists in these institutions.

Key words: Limited-stage small-cell lung cancer, Radiation therapy, Chemotherapy, Radiation oncologist, Radiation therapist

国立療養所西群馬病院における限局型小細胞肺癌の治療成績
北本 佳住[*1, *2], 中山 優子[*1], 松浦 正名[*2], 中野 隆史[*1], 土屋 智[*3], 斉藤 龍生[*3], 早川 和重[*4], 新部 英男[*1]
[*1] 群馬大学大学院医学系研究科 腫瘍放射線学（〒371-8511 群馬県前橋市昭和町3-39-22）
Department of Radiation Oncology, Gunma University Graduate School of Medicine（3-39-22, Showa-machi, Maebashi, Gunma, 371-8511 JAPAN）
[*2] 国立療養所西群馬病院放射線科
Department of Radiology, National Nishigunma Hospital
[*3] 国立療養所西群馬病院呼吸器内科
Department of Internal Medicine, National Nishigunma Hospital
[*4] 北里大学医学部放射線科学
Department of Radiology, Kitasato University School of Medicine

要旨：【目的】国立療養所西群馬病院における限局型小細胞性肺癌の治療成績をretrospectiveに検討し，日本の中規模病院で限局型小細胞癌の標準的治療を施行する際の問題点を提示する．
【対象と方法】1984年10月から2000年10月までに49例が限局型小細胞性肺癌と診断された．内訳は男性39例，女性10例，年齢は46歳から87歳（平均66歳）で，75歳以上が8例（16%）であった．全身状態は良好な患者が多く，PS：0〜1の患者が41例（84%）を占めたが，残りの8例（16%）はPS：2〜3であった．すべての患者に化学放射線療法を施行した．放射線治療は2 Gy/frの通常分割照射を原則としたが，5例に1.5 Gy/frの多分割照射を施行した．総線量は平均48 Gy（30 Gy〜60 Gy）であった．化学療法薬剤は多岐にわたるが，1980年代後期から白金製剤を基本とした多剤併用療法が中心で，49例中41例に施行された．化学療法と放射線療法を同時併用した症例が21例，継続併用した症例が28例であった．
【結果】生存期間中央値は22ヶ月であった．2，5年生存率はそれぞれ45%，18%で，2，5年原病生存率が51%，20%であった．2，5年無病生存率は23%，15%で，再発は確認できた46例のうち37例（80%）に認めた．初回再発部位としては照射野内再発のみが26%と最も多く，脳転移が15%であった．胸郭内再発と遠隔転移を同時に認めた症例が39%を占めていた．再発例のうち92%は治療後20ヶ月以内に出現し，最も遅く再発した症例は治療後48ヶ月であった．5年生存例は6例（12%）で，有意な予後因子はPSのみであった．
【まとめ】国立西群馬病院における限局型小細胞性肺癌の治療成績は他の報告と比して比較的良好であった．現在，全身状態良好な限局型小細胞性肺癌の最適な治療法は照射法として加速多分割照射を用い，全身化学療法と同時併用する化学放射線療法と言われている．ただし当院のような日本の中規模病院で治療される患者群には予後不良な因子を持った患者の割合が高くなるため，良好な背景を持った患者を対象とした無作為比較試験から得られた知見を適応する場合には注意が必要である．

CASE REPORT

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放射線治療が著効を示した修復性巨細胞肉芽腫の一例

松本 康男[*1]，山ノ井 忠良[*2]，土田 恵美子[*2]，杉田 公[*2]，笹本 龍太[*2]

A CASE REPORT OF GIANT CELL REPARATIVE GRANULOMA TREATED WITH RADIATION THERAPY

Yasuo MATSUMOTO[*1], Tadayoshi YAMANOI[*2], Emiko TSUCHIDA[*2],
Tadashi SUGITA[*2], Ryuta SASAMOTO[*2]

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Abstract: Giant cell reparative granuloma (GCRG) was first reported by Jaffe as a benign non-neoplastic process linked to intraosseous hemorrhage. These lesions in the jaw and the short tubular bones of the hands and feet frequently recur after surgery. We report a rare case: a 51-year-old male with a recurrent GCRG of the left temporal bone showing a good clinical response after 20-Gy irradiation. Although surgery is considered to be the first-line therapy for GCRG, if it has a high morbididy rate or brings a poor outcome, low dose radiotherapy with 15-20 Gy may be an alternative method.

Key words: Giant cell reparative granuloma, Solid variant of aneurysmal bone cyst, Radiation therapy, Temoporal bone

要旨：修復性巨細胞肉芽腫（GCRG）は骨内の非腫瘍性，反応性の良性疾患であって，1953年にJaffeが下顎骨の骨内出血に対する修復性病変として提唱した病理学的概念である．組織学的に多核巨細胞が多く見られるために，巨細胞腫との鑑別を要する病変として記載された．動脈瘤性骨嚢腫の充実性部分との類似性から，solid variant of aneurysmal bone cystとする文献もある．一般的には手術療法が第一選択と考えられているが，しばしば術後再発を認める．今回，側頭骨から発生したGCRGの術後再発症例に対して20 Gy/10分割という比較的低線量の放射線治療が著効した症例を経験したので報告する．手術が困難な症例や，手術療法が奏効しなかった症例には15～20 Gyの放射線治療を考慮してもよいと考える．

[*1] 新潟県立がんセンター新潟病院放射線科（〒951-8566 新潟市川岸町2-15-3）
Department of Radiology, Niigata Cancer Center Hospital（2-15-3, Kawagishi-cho, Niigata, 951-8566 JAPAN）
[*2] 新潟大学医学部放射線科
Department of Radiology, Niigata University Faculty of Medicine