



Title	The effect of beam shape on physical parameters of head and neck simultaneous-integrated boost intensity-modulated radiation therapy
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論文内容の要旨  
Synopsis of Thesis

氏名 Name	坪内 俊郎
論文題名 Title	The effect of beam shape on physical parameters of head and neck simultaneous-integrated boost intensity-modulated radiation therapy (頭頸部SIB-IMRTにおいて、LINACのビーム形状が物理パラメータに及ぼす影響の評価)
論文内容の要旨 〔目的(Purpose)〕	
<p>The increase of dose rate and the decrease of out-of-field dose can be expected for FFF beams and lead to effective and safety radiotherapy. On the other hand, the bell-shaped dose profile is thought to be a factor of negating these advantages especially in a large field. Evaluating the influence of the profile of FFF beams on the plan quality (dose homogeneity and conformity of targets, dose constraints to organs) and physical parameters of IMRT (MU values, number of segments and the distribution of segments in the irradiated field) for large and complex target volumes is essential for the clinical use of FFF beams. Our study investigated the effect of the beam profile on the physical parameters by comparing the treatment plans of head and neck SIB-IMRT created for use with flat and FFF beams. In addition, we assessed the relations between the location of isocenter and physical parameters for FFF beams.</p>	
〔方法ならびに成績(Methods/Results)〕	
<p>[Methods] Treatment plans for 15 patients with head and neck cancer were created using the XiO (version 4.8) treatment planning system (Elekta, Stockholm AB, Sweden) with the superposition algorithm and the segment weight optimization using a dose grid resolution of 2.0 mm in each direction, in fixed-gantry step-and-shoot delivery of the Siemens Artiste (Siemens Healthcare, München, Germany). Minimum segment size, MU values, which are deliverable in the IMRT, were set to <math>2.0 \times 2.0 \text{ cm}^2</math> and 5 MU, respectively. Seven gantry angles were used (<math>0^\circ, 51^\circ, 102^\circ, 153^\circ, 207^\circ, 258^\circ</math> and <math>309^\circ</math>) for head and neck IMRT. Two kind of treatment plans were created for each patient for retrospective analysis. One is with flat beams and another is with unflat beams. Then we compared parameters obtained by two different plans. The energies of primary electrons are 7 MV for FFF beams and 6 MV for flat beams, the physical characteristics of which are similar with regard to depth-dose curve, energy spectrum and surface dose. This similarity makes it possible to evaluate the effect of beam profile alone.</p> <p>[Results] No significant differences were found in the plan quality. The isocenter locations do not affect the physical parameters for FFF beams. It has been confirmed that the number of segments and MU values were 40% higher with FFF beams than with flat beams (<math>p &lt; 0.05</math>).</p>	
〔総括(Conclusion)〕	
<p>We investigated the influence of flat and FFF beam shape, and the isocenter location for FFF beams on the physical parameters of head and neck SIB-IMRT. It was revealed that the number of segments and MU values were 40% higher with FFF beams than with flat beams, and significant difference in the physical parameters for FFF beams with different isocenter locations was not observed. In addition, the conical beam profile of FFF beams required additional modulations in various regions inside the treatment volume compared with flat beams and the increase in these parameters may cause longer irradiation times with FFF beams, indicating that flat dose profile is more suitable for IMRT with large and complicated target volumes.</p>	

## 論文審査の結果の要旨及び担当者

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論文審査の結果の要旨		
<p>近年のX線治療治療では、標的（腫瘍）に対しての線量集中性を高め、腫瘍近傍の正常組織への影響を最小限に抑えるために強度変調放射線治療（IMRT）が主流となっている。IMRTではいくつもの分割された照射領域（セグメントと呼ぶ）を重ね合わせることで、正常組織が近接している症例でも治療が可能となる。</p> <p>X線治療装置で発生するX線の形状には、平坦なものとそうでないものの2種類がある。前者は、照射効率は低下するが照射野全体へ効率よく照射でき、後者は照射効率が向上し、IMRTと組み合わせることで効率的に治療が遂行できると考えられている。この2つのビーム形状を、セグメントの数や照射野内でのセグメントの分布といった物理的指標をもとに、どちらのX線分布が複雑かつ大きな照射野を有するIMRTで効率的に治療を遂行できるかを比較検討した研究内容となっている。</p> <p>X線の分布形状という基本特性に着目し、効果的な治療が出来るX線形状を示した研究内容は、博士（医学）の学位授与に値する。</p>		