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## Clinical Evaluation of Field within a Field Technique in Radiotherapy —Preliminary Report—

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### Field within a Field (F-f) 法の有用性に関する臨床的研究

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放射線治療における空間的線量分布は，organ at risk をさけ target volume に十分な線量を出るだけ均等に照射するように計画される。われわれは，治療期間を延長することなく，腫瘍の早期縮小による症状の早期緩解を目的として，Field within a field (F-f) 法を各種腫瘍に対し行ってきた。これは，一定の照射野にて照射した後，照射

野を縮小する Shrinking (S) 法に比べ，照射と同時に一定の照射野内に小さな照射野を設定するのである。

今回，頭頸部腫瘍および食道癌を中心に F-f 法の有効性を検討した。F-f 法は，治療成績の向上および患者の quality of life を考えるうえで有用である。

#### Introduction

In the dose distribution, the radiation is planned to deliver as homogenous distribution of the target volume as possible while avoiding any organs at risk. On occasion the irradiation field is shrunk field (shrinking field (S-F) method) depending on the response to radiotherapy. If the indications are properly selected, the field-within-a-field (F-f) method can be employed to obtain early regression of tumor within the target volume from the beginning of treatment, without changing the overall time. In other words, this method is intended to relieve symptoms rapidly and improve the local control rate as to give a large dose to the special target area in short overall time.

While the authors perform this method in a variety of malignancies this report primarily concerns its clinical effectiveness in cases of cancer of the head and neck and the esophagus.

#### Materials and Method

The F-f method was performed for curative treatment of 53 cases of head and neck cancer, and 35 cases of cancer of the esophagus between 1976 and 1983. It was not applied randomly in comparison to the S-F method and conventional homogenous irradiation.

At first, 180—200cGy was delivered in a single dose to the outer large field (F), followed immediately by 30—50cGy of the inner small field. This means that the inner small field (f) within the outer large field (F) receives 220—250cGy on the single fraction. Concerning calculation of the inner small field it is necessary to decide on a small as possible target volume. In general 10MV X or  $^{60}\text{Co}$   $\gamma$  ray were employed. Treatment

was administered 5 days a week. In some cases of head and neck tumors, outer large field was irradiated with  $^{60}\text{Co}$ , followed by treatment of the inner small field (f) by electron beam. The intended total dose was TDF: 99–110.

Evaluation of therapeutic effectiveness was performed according to the standards for evaluating solid tumors and the survival rate was calculated by the method of Kaplan and Meier<sup>1)</sup> while statistical significance was calculated by means of the chi-square and log-rank test<sup>2)</sup>.

## Results

### 1) Head and Neck Carcinoma

No difference was recognized between the groups of cases treated by F-f method and S-F method in terms of patient background factors such as age, sex, stage, performance status or histologic type. While there was no statistically significant difference ( $p > 0.10$ ), the F-f method showed good tumor response (Table 1a). The same tendency was observed in selected squamous cell carcinoma cases (Table 1b). Furthermore no difference was observed in terms of early or delayed side effects.

### 2) Esophageal Carcinoma

The F-f method was compared with the conventional homogenous irradiation method in terms of male cases of esophageal cancer. While no statistically significant difference ( $p > 0.10$ ) was recognized in survival rate, a tendency for longer survival was shown by the F-f method. No difference in terms of side effects and complications were recognized (Table 2).

## Discussion

There has been much discussion concerning the question of whether the times, dose and fractionation of radiotherapy performed at present are optimal or not, and there have been several reports on the effectiveness of hyperfractionation with 2–3 doses delivered in a day, or accelerated fractionation<sup>3)–8)</sup>. These all utilize variations in reactivity to radiation in terms of tissue or cell.

The shrinking field (S-F) method has been adopted in order to change the dose distribution and thereby

Table 1 Comparison of Response Rate in Head & Neck Tumor between the Field-within-a-field Technique and the Shrinking Field Technique (1976–1983)

A. All Evaluable Cases*		
	F-f(n=53)	S-F(n=41)
CR	33(62%)	20(49%)
PR	16(30%)	20(49%)
NC	40(8%)	1(2%)
PD	0	0
B. Squamous Cell Carcinoma		
	F-f(n=34)	S-F(n=28)
CR	22(65%)	16(57%)
PR	10(29%)	11(39%)
NC	2(6%)	1(4%)
PD	0	0

F-f: Field within a field Technique

S-F: Shrinking Field Technique

\*There was no significant difference in early and late effects.

Table 2 Comparison of Survival Rate in Male Esophageal Cancer between Field-within-a-field Technique and Conventional Homogenous Irradiation(1976–1983)

	F-f(n=35)	CHI(n=31)
Median Survival(month)*	12	6
2-year Survival Rate(%)	25.4	22.6
5-year Survival Rate(%)	10.7	8.1

F-f: Field within a field Technique

CHI: Conventional Homogenous Irradiation

\*There was no significant difference in early and late effects.

Table 3 Indication of Field within a Field Technique

Brain Tumor
High grade glioma
*Pinealoma
*Medulloblastoma
*Metastatic brain tumor(localized, symptomatic)
Head and Neck
Epipharyngeal ca.(locally advanced)
Hypopharyngeal ca.(locally advanced)
Anaplastic ca. of thyroid gland
*Metastatic and/or recurrent cervical lymph node
Chest and Abdomen
*Esophageal ca.
Primary breast ca.
*Bile duct ca.
Malignant Lymphoma(bulky mass)
Others
Soft tissue tumor
SVC syndrome
*Tumor with neurological symptoms

\*most commonly used disease

reduce complications and improve local control<sup>9)</sup>. This involves follow-up irradiation of a smaller field after irradiation of a larger field following a certain period of time, which as a result involves extension of the period of irradiation. The F-f method involves simultaneous irradiation of both fields<sup>10)11)</sup>. This method makes it possible to increase the dosage of radiation delivered to the small area centered upon the tumor, without increasing the overall time necessary for radiotherapy.

In accelerated fractionation, the early reaction in the mucosa sometimes necessitates cessation. Thomas and Withers<sup>11)</sup> consider that when changing the dosage per treatment and delivering 2—3 doses per day, in terms of the late effects (early effects can be ignored) unless hyperfractionation of amounts less than 200cGy conventional radiation is performed no therapeutic gain will be obtained. In the F-f method, while some degree of complications can be envisaged due to the increase in the inner small field per dose, because this can be targeted at the minimum field possible, such complications should not be serious. In other words the F-f method is aimed at relieving the patient from the main symptoms troubling him by rapid improving local control, and it is important to plan the minimum necessary target volume of the inner small field. Also depending on the site of the lesion, it is important to employ electron beams<sup>12)</sup> in order to minimize the volume dose.

The authors have employed this method in the treatment of brain tumors, head and neck tumors and tumors of the gastrointestinal tract as well as cases of vena cava superior syndrome and tumors with neurological symptoms which have indication for emergency radiotherapy (Table 3)<sup>13)~15)</sup>. Further studies will be performed in order to obtain improved local control and minimize delayed reaction by combination of hyperfractionation and accelerated fractionation.

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