

CURRENT STATUS OF CLINICAL PARTICLE
RADIOTHERAPY AND CRITICISM AGAINST IT

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In recent years, a large number of institutions throughout the world have conducted clinical trials of heavy particle radiotherapy using fast-neutron, proton, pion, and heavy ions. A stimulation of using these heavy particles has come from the fact that approximately one-third of tumor deaths are caused by local failures despite recent advances in the field of supervoltage radiotherapy in local tumor control. The heavy particles have unique characteristics in the sense of depositing high-LET radiations or providing favorable dose distributions, hence giving a potential to improve local control rates while keeping radiation injury within acceptable limits.

Up to now, more than 100,000 patients in the world have been treated by various types of heavy particles. However, the majority of them are still investigational modalities, and optional treatment techniques and dosage schedules have not yet been established. An exception among them may be an outstanding success of proton therapy for choroidal melanoma at Moscow, Cambridge (USA), and Berkeley. Stimulated by this success, a 72 MeV proton accelerator is under construction at SIN with a main aim of treating choroidal melanoma, and also in Japan, clinical trials of proton therapy are being conducted at NIRS and Tsukuba University.

Among heavy particles, fast-neutron has been used most widely at almost 20 institutions in the world. However, results of this modality are still controversial partly because of differences in physical and radiobiological properties of the neutron beams available for each clinical use, and favorable results have been shown from only a few institutions. Nevertheless, comparison of promising results from Hammersmith and some other centers may lead to provide more definite criteria in near future for determining the adequate type of malignancies for fast-neutron therapy.

As with pion radiotherapy, it first started at LAMPF (USA) in 1976 followed by TRIUMF (Canada) and SIN (Swiss), and up to now more than 250 patients have been treated in these institutions. Unfortunately, pioneer study at LAMPF was terminated in 1981 from several reasons. The clinical efficiency of pion therapy has not been clarified, yet there is no doubt that it is an attractive modality and favorable results of pion beams can be expected from SIN and TRIUMF.

At the University of California Lawrence Berkeley Laboratory, radiation therapy with helium and heavier particles such as carbon, neon, argon and silicon ions is being studied determine its role as a therapeutic modality in the treatment human cancers. Since 1975, steady progress has been made in development of treatment techniques, dosimetry and treatment planning. From 1975 through 1982, approximately 300 and 90 patients have been treated by helium ions and heavy ions, respectively and in some type of malignant tumors, promising results have been shown.

In summary a majority of the particle therapies are still investigational, yet it is not far from the point of achieving favorable results by those modalities.

Clinical Particle Therapy

<u>particle</u>	<u>proposed</u>	<u>approximate No.</u>
n	Lawrence, Zirkle and Stone(1936)	8,000
p	Wilson(1946)	2,500
Heavy ions	Wilson(1946) Tobias(1960)	90
pions	Fowler and Parkins (1961)	250