Magnification Device of Computed Tomography in Radiation Therapy Planning

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Computed tomography (CT) adds a new dimension in the study of body contour, organs, and tissues as well as various pathologic conditions. This modality provides a great degree of accuracy in radiation therapy planning (RTP). However, CT images are usually taken on a small reduced format so that possible errors can be made during inputting the CT data into an automatic planner.

Authors have designed a simple inexpensive magnifying device of CT images to obviate errors created by reduced image.

Key Words: CT, Radiation therapy planning, Automatic planner, Magnifying device.

INTRODUCTION

Since early 1970s, computed tomography (CT) has been accepted as an almost venerable method to investigate the malignant disease in terms of the detection of tumor, assessment of its extension or spread, and even the histologic diagnosis[1~3]. In addition to its diagnostic application, CT has been used for radiation therapy planning (RTP). Compared with the ordinary small reduced format, the life size CT image has advantages of minimizing distortion of the body contour, of correct estimation of tumor volume and of critical identification of surrounding vital organs. Unfortunately, however, the image size of CT scanning is usually not life size. With a simple magnifying system consisting of an overhead projector, an infusion stand (pole), and a mirror, we were able to obtain life size CT image very easily from small multiformat images. The magnified image so obtained is projected on the graphic table of a treatment planning computer (Therac 2000) to input the patient's anatomical data such as body contour and tumor volume.

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METHODS AND RESULTS

Treatment planning computer for RTP has been used at the Division of Radiation Therapy, Department of Radiology, Catholic Medical College since March 1983.

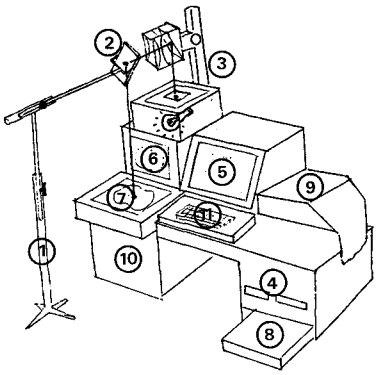
To magnify the small multiformat CT images into life size, an overhead projector and infusion pole with a reflective mirror were arranged as shown in Fig. 1 and 2.

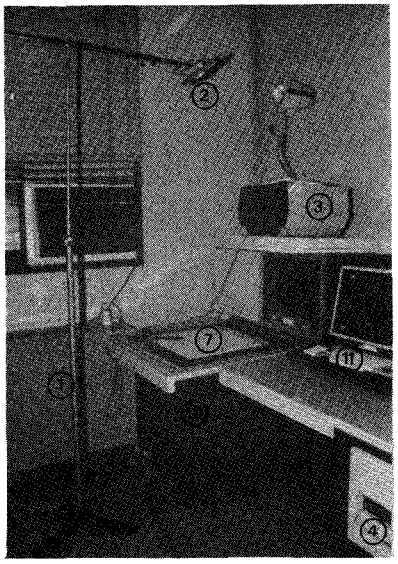
Multiformat CT image was laid on the projective field of the overhead projector to be transmitted and reflected over the graphic table of a therapy planner with life size scale. To obtain a life size CT image over the graphic table, simple adjustment of the height of the head (lens) of overhead projector and that of infusion stand with mirror (Figs. 1 and 2) was necessary.

A radiotherapist can trace and draw the transmitted shadow over the graphic table showing patient's contour and internal anatomical structures (Fig. 3). This system reduces the error made inevitably in the course of inputting patient's data obtained from multiformat CT images to therapy planner.

DISCUSSION

CT contributes to the treatment planning process in at least six items. They are contour definition





1. I. V. pole
2. Mirror
3. Overhead projector
4. Floppy disk equipment
5. Operator console display
6. Image display equipment
7. Graphic table
8. Digital plotter
9. Printer
10. Treatment plan processing equipment
11. Key board

Fig. 1. (Left) & Fig. 2 (Right) Therac–2000 appearance, Overhead Projector and I. V. Pole with mirror.

Fig. 3. Life size CT image on the graphic table which are to be entered the data with digitizer (▲).

of the patient, tumor localization, normal structural localization, inhomogeneities of the tumor, three dimensional reconstruction, and evaluation of tumor extent[1,3]. As the result, CT has greatly enhanced radiotherapist's ability to perform improved treatment with reduced rate of radiation induced complications.

In the course of RTP, conventional X-ray and CT images can be used to put the anatomical data into a treatment planning computer. Conventional tumor localization is performed normally with radiotherapy simulator and orthogonal simulation X-ray films of the treatment area are taken with contrast medium where appropriate. A transverse

body contour may be taken using plaster of Paris or flexible wire. The radiotherapist localizes the treatment volume on the radiographs by using informations derived from clinical examination, surgical findings, and conventional imaging technique[2]. Finally, the treatment volume is transferred to the transverse-section together with the position of any relevant normal structures and then a treatment plan is drawn using an automatic planner.

In practice, about a half of patients had their work-up CT images taken outside hospitals. So, it is not always easy to apply RTP with CT-linked treatment planning system. Most of available diagnostic CT images were taken with reduced format only to permit the error tracing the body contour or tumor volume during RTP. Life size CT in RTP is essential in reducing the possible error and thus permits to make correct RTP.

CONCLUSION

It is evident that magnified life size CT images using an ordinary overhead projector and some simple inexpensive device are useful to obviate the possible error which would be made during inputting the patient's anatomical data obtained from multiformat film into the treatment planning computer.

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= 국문초록 =

방사선치료계획을 위한 진단용 CT 영상의 확대장치

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최근 방사선치료영역에 있어 CT의 역할은 매우 중요시 되고 있다.

종래의 병기결정등 진단적가치 이외에도 방사선치료분야에 있어서는 환자신체의 윤곽 종양침습범위, 인접 정상구조물의 위치, 조직불균질성의 정도 등을 정확하게 파악할 수 있고 입체적영상의 재구성도 가능하여 주위 정상조직의 손상없이 충분한 종양치료선량을 조사하는데 있어 거의 필수적이라고 까지 할 수 있다.

이와 같은 진단용 CT상은 모두 실물크기를 일정 비율로 축소시킨 영상으로 기록 및 보관되고 있는 바 방사선치료계획시 이 축소된 CT상을 치료계획용 콤퓨터에 입력할 경우 같은 CT영상 일지라도 치료의사에 따라서 또 입력할 때 마다 조금씩 차이가 생길 수 있음으로 이와 같은 오차를 줄이기 위하여는 실물크기의 영상이 필요하게 된다.

저자들은 축소된 CT영상을 실물크기로 확대하기 위하여 overhead projector(3M사제)와 평면거울을 부착시킨 정맥주사용 pole을 이용하여 값싸고 간단한 장치를 고안하였으며, 이를 사용하여 쉽게 실물크기영상을 치료계획용콤퓨터(Thenac 2000, NEC제)의 입력판위에 얻을 수 있었기에 보고하는 바이다.