Multi-Institutional Database System for The Aid of Improvement in Radiotherapy Results

Masatoshi Ishibashi[a], Hajime Harauchi[b], Hiroko Kou[a], Yu Kumazaki[a], Keiji Shimizu[a], Masako Harano[b], Hodaka Numasaki[a], Munenori Yoshioka[b], Kiyonari Inamura[b]

[a] Graduate School of Allied Health Sciences, Faculty of Medicine, Osaka University.
[b] School of Allied Health Sciences, Faculty of Medicine, Osaka University, Faculty.
e-mail: masa1484@sahs.med.osaka-u.ac.jp

ABSTRACT

A learning system was built into an on-line, multi-institutional radiotherapy database, where the treatment history records and the results in each institution were integrated, each radiotherapy planning was supported, and it led to the improvement in treatment results.

Keywords: radiotherapy, multi-institutional database, learning system, security enhancement, treatment optimization

1. INTRODUCTION

In radiotherapy, skill of a radiotherapist is improved by his experience of drawing up optimized radiotherapy plan. Accu mulation and management of such individual experience also contribute to the improvement and a bottom rise in radioth erapy results at large. Then, a learning system is built into an on-line, multi-institutional radiotherapy database, where the treatment history records and the results in each institution are integrated, the results are analyzed statistically and s hown, and each radiotherapy planning is supported. The improvement in radiotherapy results leads to the increase in the number of clinical data of high quality. Also it leads to fullness of a database which can always show the newest and th e optimal treatment method. Such learning system makes again the results of radiotherapy improve further. Thus, the da tabase aided improvement in radiotherapy results incorporating such learning system will produce better circulation bet ween three components, namely, database, treatment planning, and radiotherapy results.

2. MATERIALS

This study is based on ROGAD (Radiation Oncology Greater Area Database) which collects the clinical records and res ults of radiotherapy from related medical institutions in Japan. ROGAD is planning an on-line system which uses the Internet from this year 2002 in addition to the conventional off-line system. ROGAD was built in 1992 and had conducted nine times of clinical record investigations and six times of f ollow up investigations in these ten years. Three hundred and twenty five institutions among 725 radiotherapy institutio ns of the whole Japan had been registered, and 13,448 effective cases were collected, scrutinized and analyzed. A record of one patient in ROGAD is composed of data elements of 13 categories and 52 items, such as tumor information, pati ent's status information, treatment method information, and treatment result information. That is, it can be said that RO GAD is one of the most appropriate data sauce for showing the optimal treatment plan using statistics toward building u p a learning system. ROGAD has three modes of data collection as follow, (1) Handwriting using worksheets, (2) The k ey input using the registration program developed in the ROGAD office, (3) The linkage with radiotherapy database wh ich exists in an institution. Data conversion to the ROGAD protocol is necessary to be linked. The ratio of the key input made mentioned above 2) is 78% in number of institution and 77% in number of clinical cases registered. This figures t ell that treatment planning support using the learning system at the time of a prospective registration of each case by ke y input works very well and its effectiveness is mostly expected to improve the individual result, and even a bottom rise of results of radiotherapy in whole Japan. Furthermore, ROGAD starts the on-line web registration method which goes via the Internet as the 4th registration method in addition to three methods m entioned above this year. ROGAD using Internet of high interactivity and high speed offers most effective environment where the learning system presents the latest statistics.

3. METHODS AND RESULTS

The outline of the multi-institutional database incorporating the learning system which we developed is as follows.

1) By implementing a authentication function, the on-line ROGAD is accessed by only a registrated institution, and

real clinical records are registrated into ROGAD server, without making a patient's privacy leaked to the Internet. Besides, on-line operation of ROGAD can bring us rapid version up of data source in our learning system, so that it become possible to get treatment planning making the most of the latest treatment result.

2) At the time of registration, an input value is easily led to a proper value by employing an agent-oriented data check function and a template function stated later in order to raise reliability of data sauce.
3) The treatment plan proposal shown by the template is worked out by means of taking statistics from cases registered in ROGAD and the learning system. The radiotherapy method which had the best result is selected and shown.
4) When statistics is made by the learning system, the best condition of therapy is extracted automatically by mean of determining boundary value which divides an object group so that a significant statistical difference is observed.
5) When information is shown by the learning system, a sample picture including the irradiation field information relevant to the case is also shown in addition to the irradiation method at the time of specifying an object case.
6) Data with high accuracy are added to ROGAD by 1) to 5) above mentioned. By this, a learning system will hold data sauce with high accuracy. At the time of treatment planning, a learning system shows the irradiation method that is optimized, and it leads to the improvement in treatment results.

The outline of software functions of our make is as follows,

1) Access authentication function

In case ROGAD server is accessed, authentication function works. Because the browser of our original development is used, URL (Uniform Resource Locator) is concealed. Even if URL should be revealed, the perusal from a general browser is impossible, because Session of ASP (Active Server Pages) is acquired at the time of attestation.

2) Patient ID information security maintenance function

The registrated information is composed of patient ID information and treatment history information. Patient ID information is saved at the hard disk of Client PC, and treatment history items which are enciphered by SSL (Secure Socket Layer) are stored via the Internet at ROGAD server.

3) Agent-oriented data check function

At an on-line registration, the logical check of careless mistakes is performed automatically and a wrong value if any, is led to the right value. Namely, after both an input value and the regulated value in registration software are compared each other and input value has been recognized as an unjust value, the right value is shown.

4) Template function

When primary tumor region code, pathology code and UICC stage code are entered by an operator, the function of temp late starts and accesses the database, extracts the corresponding case, and presents them on a template, so that a package d data registration will be supported. Namely, when there are many cases of the same topographical region or the same group of diseases in an institution, the time and effort of an input can be saved and an accurate registration can be perfor med.(figure.1)

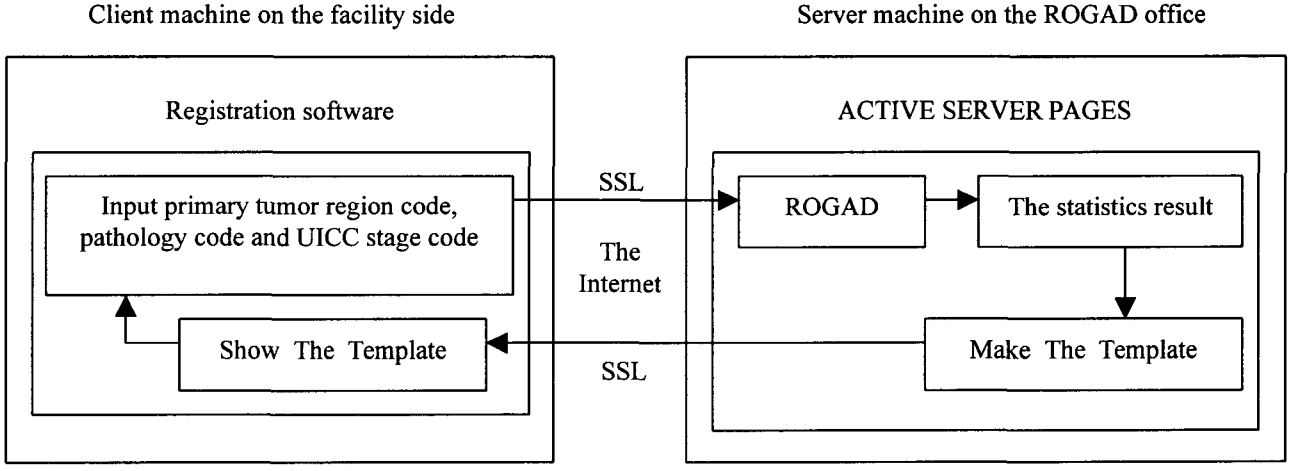

Fig.1 Workflow of template function

5) Learning system function

This main function of our software is to deduce the treatment plan case group whose results of treatment were the best

from the statistics result of the past ROGAD to the case. But it has an additional function of showing patterns of irradiation which serve as a model, and showing a template of the optimal treatment plan. Registrated information is being reflected periodically to a statistics result.

6) The function to make statistics in the optimal extent of cases distribution

When there are two or more object groups of clinical cases for making statistics, statistical result would not be correct if the object groups are simply divided and compared by average values, or the medians, etc. Then, a function is added in order to extract automatically the boundary value which divides an object group so that a significant difference may be figured out statistically.

7) The function which displays sample pictures which can contribute as irradiation field information

The function is added in order to specify a case type from primary tumor region code, pathology code and UICC stage c ode, and to show sample pictures, involving PTV(Planning Target Volume), CTV(Clinical target volume), etc. Informati on acquired visually, such as the irradiation angle, field sizes and a filter, is expressed as a picture. The effect of a learni ng system is heightened by adding the pictures which indicate site and position of tumor, such as irradiation field inform ation. They were not able to be acquired from the conventional ROGAD and be presented to the templates of a learning system.