

Radiotherapy equipments for conformal radiotherapy and IMRT in the Czech Republic

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Introduction

Lately huge development of radiotherapy can be observed both in the world and in the Czech Republic. Conventional radiotherapy with 2D planning and alloy blocks is being replaced by 3D conformal radiotherapy. New methods, as intensity modulated radiation therapy (IMRT), image guided radiation therapy (IGRT) etc. are being introduced into the practice. A great renovation and extension of modern irradiation techniques and accessories is connected with it. Quality assurance must be adequately developed, standards for good practice must be followed.

The development of the equipment of radiotherapy departments in the Czech Republic is presented here. The data from the special questionnaire from 14 workplaces with linear accelerators with multileaf collimators (MLC) and electronic portal imaging device (EPID) are included. They show not only the equipment specification but also the application methods, the quality control, plans for future etc.

History and present

The history is presented in the figure 1. The number of linear accelerators (LA) significantly increases and several new machines are being installed at present. Linear accelerators completely substituted betatrons and they also substitute some cobalt units. Old cobalt radionuclide units (Chisostat, Chisobalt) were replaced in most cases by new type of irradiator (Teragam). The number of cesium units slightly decreases but they are still used for nontumorous radiotherapy as well as therapeutic X-ray machines. Their number decreased significantly but 4 new X-ray machines were installed recently. At present, there are 27 radiation oncology departments and 10 workplaces, where only palliative or nontumorous radiotherapy is performed in the Czech Republic. The present situation is shown in the figure 2 and in the table 1.

Figure 1: Equipment – history

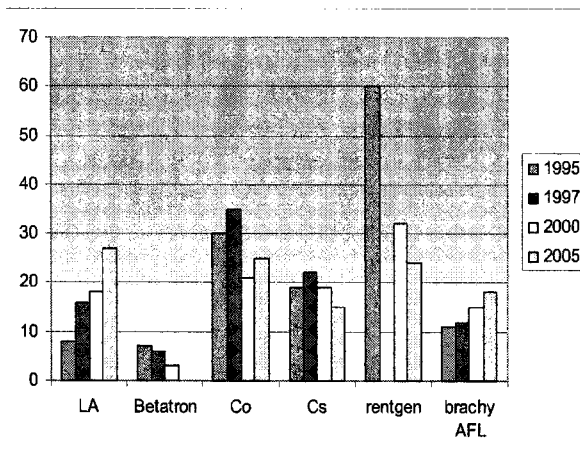


Figure 2: Radiotherapy workplaces – present

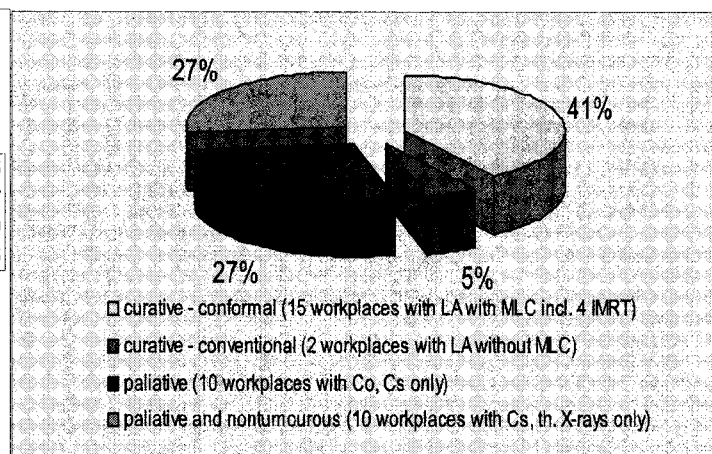


Table 1: The number of radiotherapy units in CR at present

Irradiator	Number	Specification	Number	Specification	Number
Linear accelerator	27	without MLC	11	with MLC	16
Cobalt unit	19	Chisobalt, Chisostat	7	Teragam, Theratron	12
Cesium unit	14				
X-ray unit	25	old	21	new	4
Brachytherapy AFL	18	HDR	13	LDR	5

Results from the questionnaire

Equipment for conformal radiotherapy

Distribution of LA according to the producer, date of installation, number of leaves of MLC (one workplace has micro MLC BrainLAB), and detector of EPID is presented in next figures. Dosimetry protocols used in CR are presented in figure 6. Elekta Synergy with Cone beam CT was installed in one workplace, but cone beam has not been brought into practice yet. So no experience with IGRT or respiratory gating has still been in CR.

Figure 3: Distribution of LA with MLC according to the producer

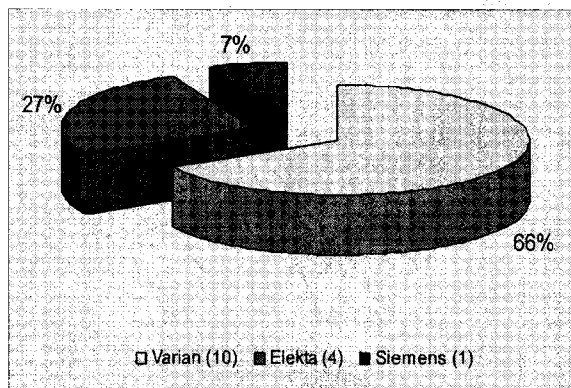


Figure 4: Distribution of LA according to the installation date

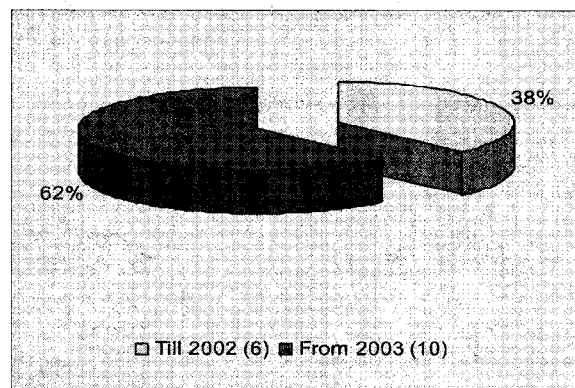


Figure 5: Distribution of LA according to the total number of leaves

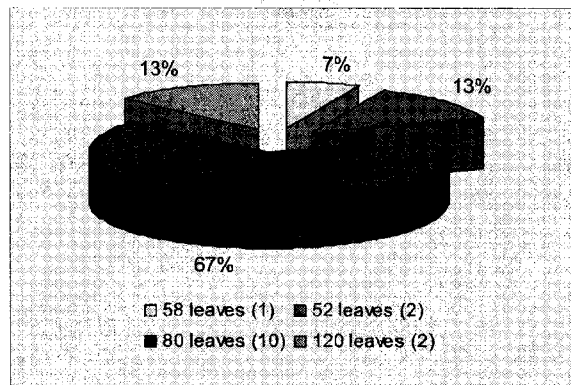


Figure 6: Dosimetry protocols used in CR (in workplaces with LA with MLC)

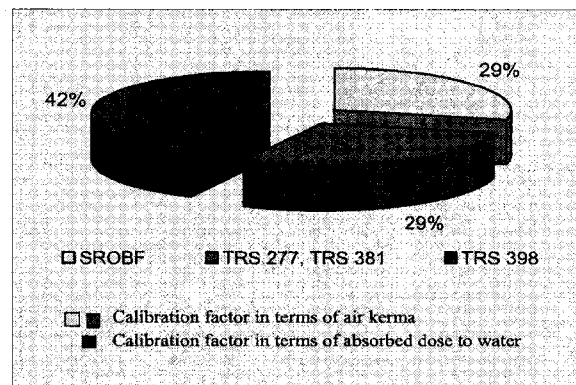


Figure 7: EPID

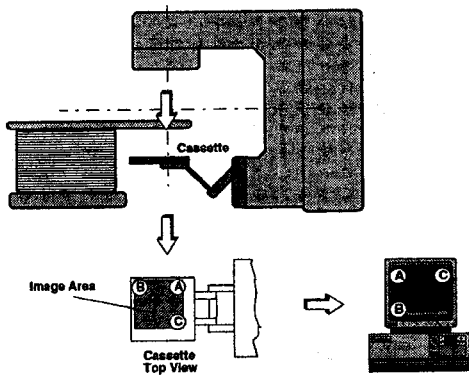
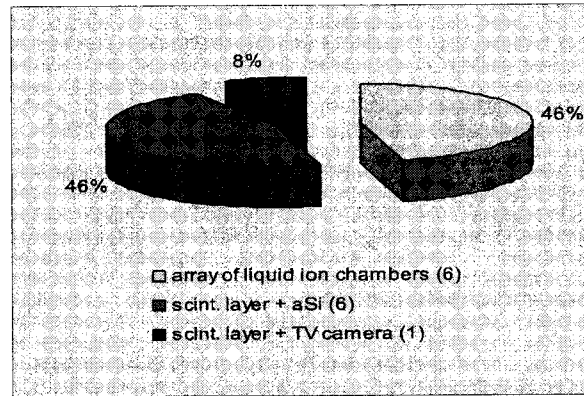


Figure 8: Distribution of EPID according to the detector



Techniques of conformal radiotherapy used in the Czech Republic

Dynamic MLC is used for IMRT in 4 workplaces (figure 10, table 2). Percentage share of IMRT is 30 %, resp. 3 %, resp. 10 %, resp. 1% to static MLC usage. The rest of workplaces use MLC only for field shaping instead of conventional blocks. Six workplaces are going to introduce IMRT in the near future. EPID is used for the verification of the patient position during radiotherapy. It can also be used for relative dose distribution verification (for this purpose it is used in one workplace in CR).

Simple image of techniques used in external radiotherapy mentioned in this paper is presented in the figure 9.

Figure 9: Techniques in external radiotherapy

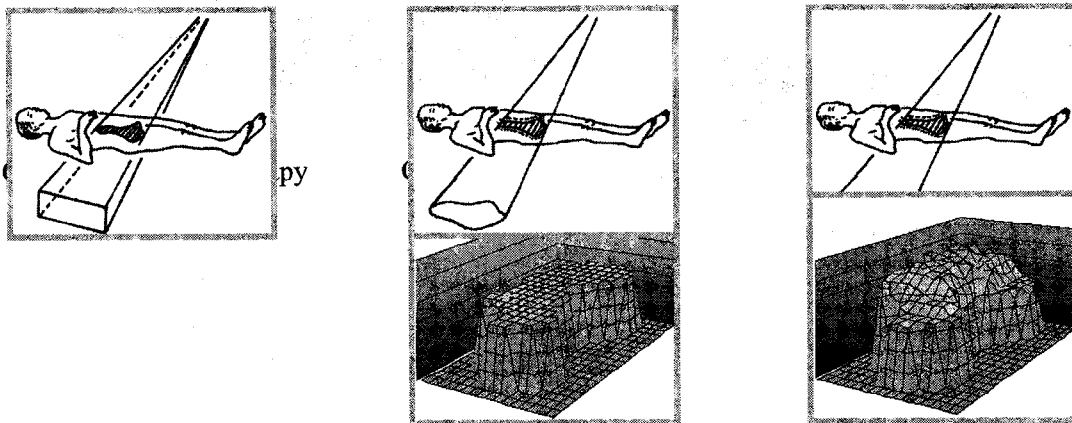


Figure 10: Use of IMRT in CR

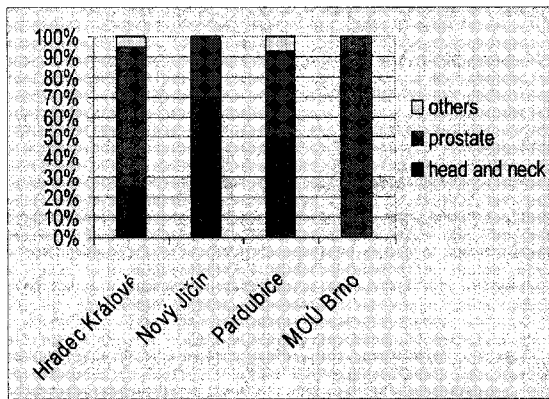


Table 2: IMRT – number of patients

		HK	NJ	Pard.	Brno
Head and neck	In total	34	15	77	-
	Last year	20	15	59	-
Prostate	In total	89	5	77	9
	Last year	56	5	50	9
Others	In total	23	-	8	-
	Last year	10	-	12	-
Patients in total		146	20	162	9
Patients last year		86	20	121	9
In total		337			

Conclusion

In the Czech Republic, a great extension of modern irradiation techniques and accessories occurs at present. Together with it, it is necessary to develop quality assurance of the whole process of dose delivery to the patient. It is also necessary to assure further education and training of hospital staff. Modern radiotherapy techniques demand sufficient amount of all sources including personal sources.

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