THE TENTH YEAR OF THE ORLEANS NEUTRONTHERAPY FACILITY

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20 September 1990 will be the tenth birthday of the first neutron beam at the Orleans neutrontherapy facility.

20 January 1991 will be the tenth birthday of the first treatment.

Up to 1989, 1004 patients have been treated with fast neutrons according to three different protocols : mixed schedule, neutrons boost, neutrons only.

Distribution of patients is reported on table 1.

Tumour location	Number of patients
High grade astrocytomas	219
Uterine cervix	146
Bronchus carcinomas	116
Rectum	113
Head and Neck	137
Sarcomas	91
Prostate	48
Bladder	28
Others + metastasis	106
Total	1 004

Table 1 : Distribution of patients treated at the Orleans neutrontherapy facility from 1981 to 1989.

Pilot studies have been initiated and managed with parisian centers : neutrons boost for rectum carcinomas and for bronchus carcinomas, neutrons boost and concentrated irradiations for high grade astrocytomas.

For other tumor types or locations, protocols are derived from the current international practice (1).

Clinical results are in general good agreement with published data but the actual trend is to increase the proportion of neutron dose for mixed schedule and boost.

1990 is a tenth birthday for the technical staff of the neutron facility and this work shortly reports some technical data of clinical relevance.

From 1981 to 1989 treatment plannings became more and more sophisticated but basic data for dosimetry and radiobiology have not been modified.

Table 2 reports some physical and technical steps.

1980 :	- DOSIMETRY with ionization chambers according to ECNEU protocol. - RELATIVE BIOLOGICAL EFFICIENCY (2). - MICRODOSIMETRY.
1982 :	- IRREGULAR IRRADIATION FIELDS (3). - NEUTRON SPECTRUM with activation detectors (4).
1983 :	- SEMI-THICK BERYLLIUM TARGET : optimisation of the target/filter thicknesses (5). - INHOMOGENEITIES : depth dose distributions for lung inhomogeneities. - A150 CALORIMETER : direct calibration in the Orleans neutron beam of chambers in term of absorbed dose (6).
1985 :	- FLATTENING FILTERS, COMPENSATORS.
1986 :	- RADIOBIOLOGICAL INTERCOMPARISON (7). - EORTC MICRODOSIMETRIC INTERCOMPARISON (8).
1987 :	- RADIOPROTECTION with TE proportional counters (9).
1989 :	- New 3D TREATMENT PLANNING SYSTEM with CT scan data (Theratronics).

Table 2 : Physical and technical steps at the Orleans Neutrontherapy Facility.

The optimum target and hydrogenous filter thicknesses for dose rate and depth dose were derived from the results in table 3.

Δ E (MeV)	FILTER THICKNESS (cm)	DOSE (%)	Dmax/2 (cm)
34	1	100	10.5
	4	73	11.0
	6	60	11.3
15.8	1	82	11.3
	4	61	12.0
	6	52	12.2
11.8	1	69	11.6
	4	53	12.2
	6	45	12.4
8.5	1	56	11.8
	4	43	12.3
	6	37	12.5

Table 3 : p(34)+Be neutron beam : dose rate and penetration as a function of targe thickness and beam filtration.
The underlined data are related to the original thick target and the semithick one now in use.
Column :
1- Proton energy lost in the target.
2- Total hydrogeneous filter thickness (10 mm perpex for light simulation and additional polyethylene filter).
3- Relative dose at Dmax per unit proton charge, normalized for the thick target with the minimun filter thickness.
4- Depth of Dmax/2 for a 10cm x 10cm field and SSD 135 cm.

The main physical characteristics of the p(34)+Be(15.8) Orleans clinical neutron beam are listed in table 4 (10).

SSD	(cm)	169
Dose rate at Dmax	($cGy.min^{-1}.\mu A^{-1}$)	0.27
Depth of Dmax/2 in water	(cm)	12.8
Build-up: 0.9 Dmax	(cm)	0.2
Dmax		0.7
$D_g/D_{(n+g)}$: - 2 cm	(%)	5.2
-10 cm		7.0
80%-20% penumbra width, -10 cm in water	(cm)	1.9

Table 4 : Physical characteristics of a 10 cm x 10 cm reference field for the filtered neutron beam p(34)+Be(15.8)

As far as treatment planning is concerned, irregular fields are routinely planned since 1982 with no limitations for the field shapes up to 19cm x 19cm (3). Dose attenuation through the 20cm thick iron blocks is more than 97 % for a narrow beam.

Combinations of the different heavy collimator devices and basic filtrations routinely used do not significantly affect the beam quality. So conclusions were derived from the dosimetric data and the many microdosimetric spectra on axis and off axis for several configurations partly reported in (8).

Calculations of dose distributions are performed with a Theraplan-Theratronics computer.

When necessary, compensator filters are designed to optimise dose distribution : so filters are routinely used in the place of wedge and bolus since 1989.

Fields are daily confirmed with ordinary therapy verification films (10).

Radiation hazards around the collimators and the treatment-room were reported elsewhere (9-11) : the low level of induced activity is mainly due to the medium neutron energy.

The cyclotron and the neutrontherapy facility have been running since 10 years without large technical breakdowns.

During the four last years only two treatment days were cancelled but without modification of the overall treatment time for any patient.

This aspect can be pointed out as conclusion from the running Orleans experience. Nevertheless, in this short special paper, it would be necessary to repeat that such special therapies should be considered by clinicians, physicists and technicians like classical therapies and conducted in the same way.

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