

15 years of proton therapy in South Africa - F. Vernimmen





Clinicians involved in the program

E. Mills
V. Levin
F. Vernimmen
J. Wilson
C. Stannard
J. Harris
J. Parkes
S. de Canha

STAFF AT ITHEMBA LABS

2

PROTON BEAM HAS MAINLY BEEN USED FOR RADIOSURGERY PURPOSES

- limited treatment days per week
- small field (10 cm circle), passively scattered beam
- stereotactic positioning chair

3

200 MeV Fixed Horizontal Beam in Proton Vault



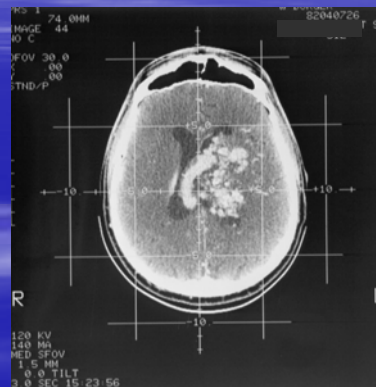
5

PROTON THERAPY TREATMENTS

DIAGNOSIS	NUMBER OF PATIENTS (10 Sep 1993 – 31 March 2008)
Acoustic neuroma	64
Angioma	15
Arteriovenous malformation	81
Brain tumor	60
Craniopharyngioma	14
Eye and orbit tumor	33
Head and neck carcinoma	11
Meningioma	41
Metastasis	33
Paranasal sinus carcinoma	23
Pituitary adenoma	62
Prostate carcinoma	4
Skull base tumor	28
Sundry	31
	500

6

ARTERIOVENOUS MALFORMATIONS

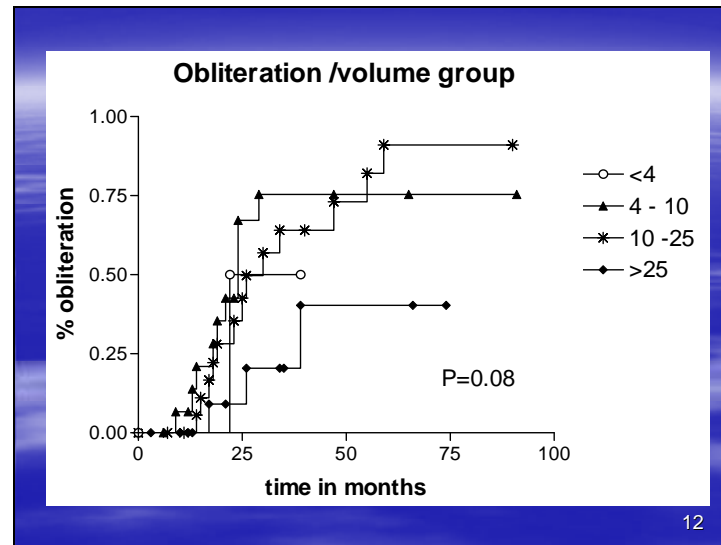
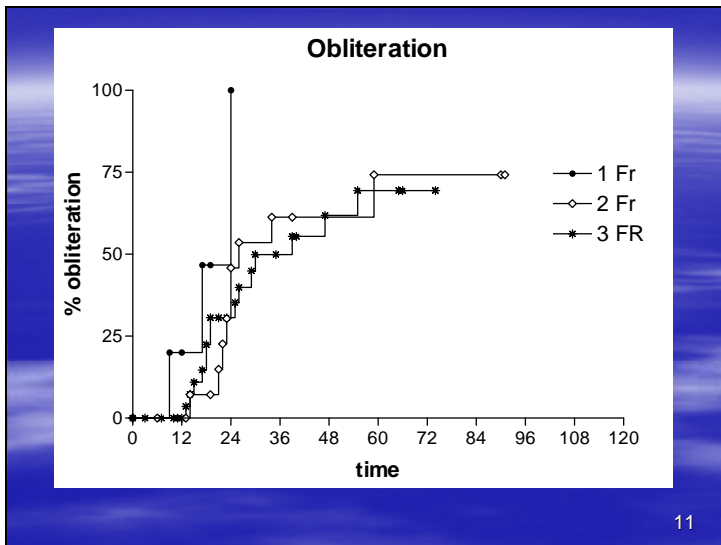
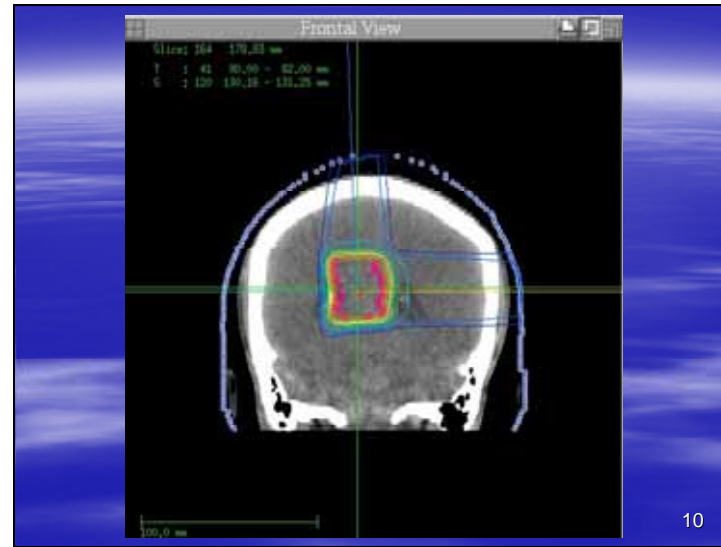
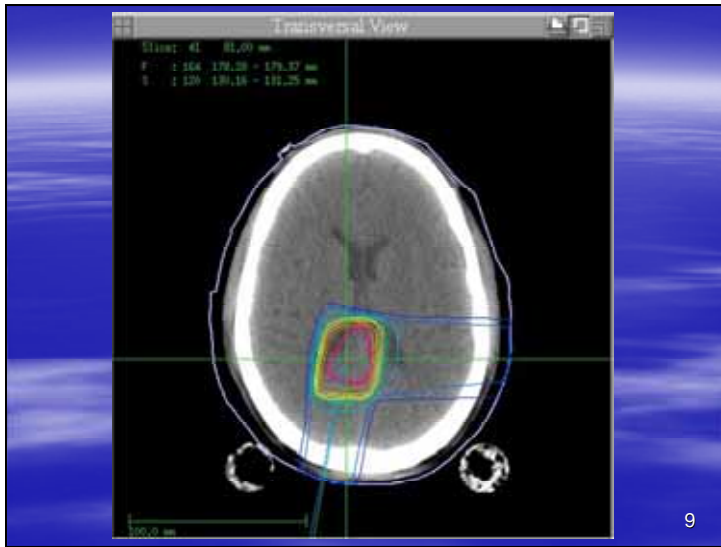


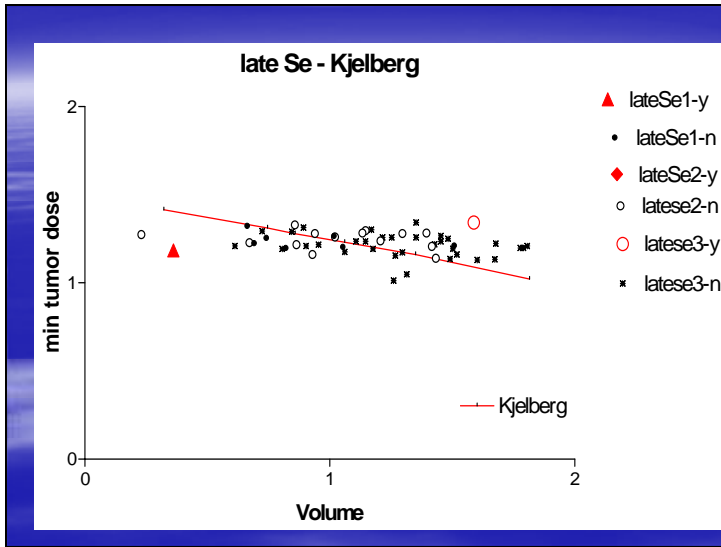
7

PATIENT CHARACTERISTICS

- Median age = 33 years
- Mean volume = 19.1 cc (1.7 – 64)
- Median ICRU reference dose = 19.7 SFE CGyE , Mean Min Target dose = 17.2 SFECGyE
- Median FU time = 6.5 years
- Overall obliteration = 49%
 - volumes < 10 cc = 61%
 - volumes > 10-25 cc = 62%
 - volumes > 25cc = 18%
- Clinical outcome
 - better 30%
 - stable 51%

8



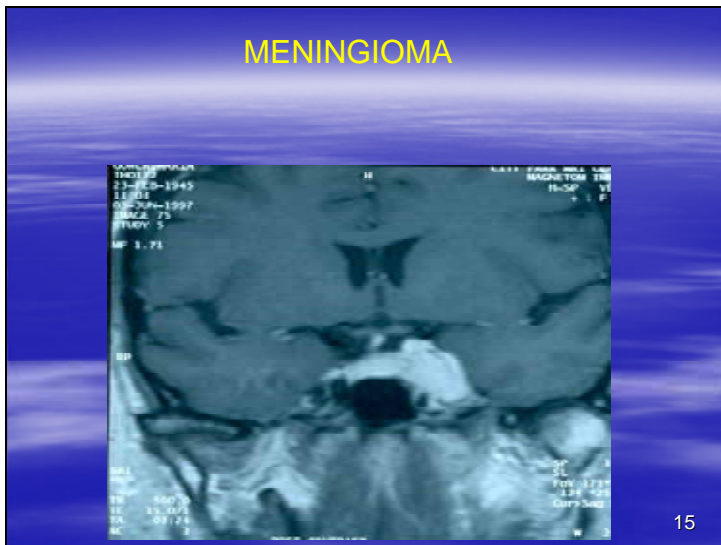


AVM Results – Large Volume Comparison

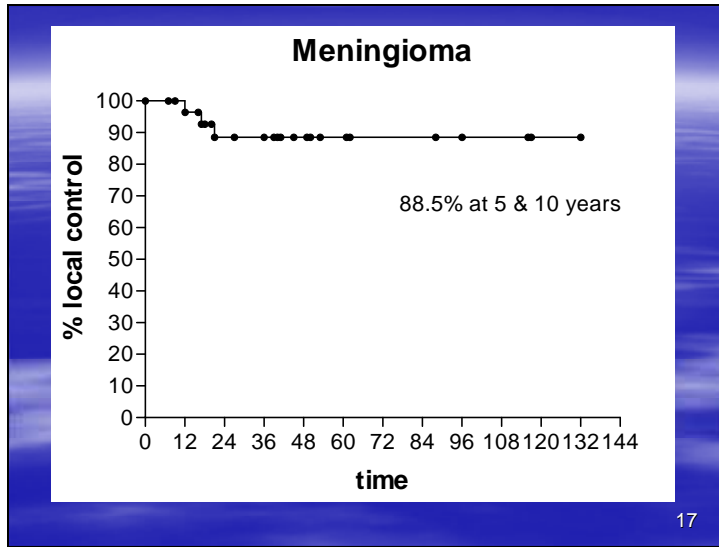
Author	Volume	% Observation	Side Effects	Margin dose Technique
Hsu-Chi Fan	10-15	77%	3.9%	15-18 Gy / 1 F Gamma knife
Choe	>15 4 cc mean	23% 24%	5%	20 Gy / 1 F Gamma knife
Verschuyl	14 cc mean	80%	(high dose group) 18%	7 Gy x 6 Linec
Hsu	4-14	53%	8.7%	5 Gy x 6 Linec
Lindvall	4-10	56%	51%	18 Gy overall Gamma knife
Munro-Herlitz	>10	12.5%	3.4%	10-15 subgroup Gamma knife
Zabel-da-Silva	4-10	54%	5%	6 Gy x 5 Linec
Engelhart	4-10	54%	3%	7 Gy x 5 Linec
Miyazaki	4-13.9	56%	14%	15.4 / 1 F Linec
Fabrizzi	4-10	40%	2%	17 Gy (15-19) 6.5 Gy / 4-5 F
Engelhart	4.2-33.5	75%	4.3%	Linec 1 F
Miyazaki	>33.3	50%	18%	23.6 Gy Inventik dose
Fabrizzi	2.04 cc	27%	14%	16 Gy (split dose) Linec

* Corresponding volume proton results from 11 bench LABS
RT = Hyperfractionated stereotactic radiotherapy

14



- ## PATIENT CHARACTERISTICS
- Median age = 52 years (3/1 F/M)
 - Mean volume = 19.4 cc (2.6 – 79.8)
 - Mean ICRU reference dose = 17.9 SFE CGyE (15 CGyE => 90%)
 - Mean FU time = 6.2 years
 - Radiological control = 91%
 - Clinical improvement = 55%
- 16

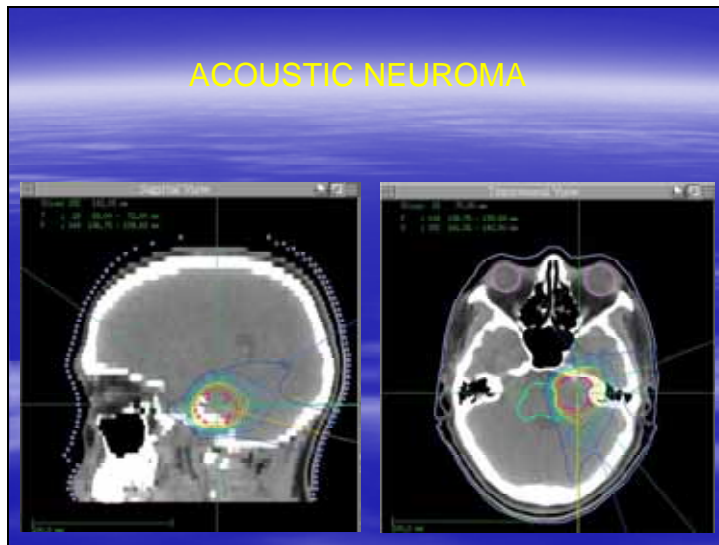


17

Radiosurgery for Skull Base Meningiomas

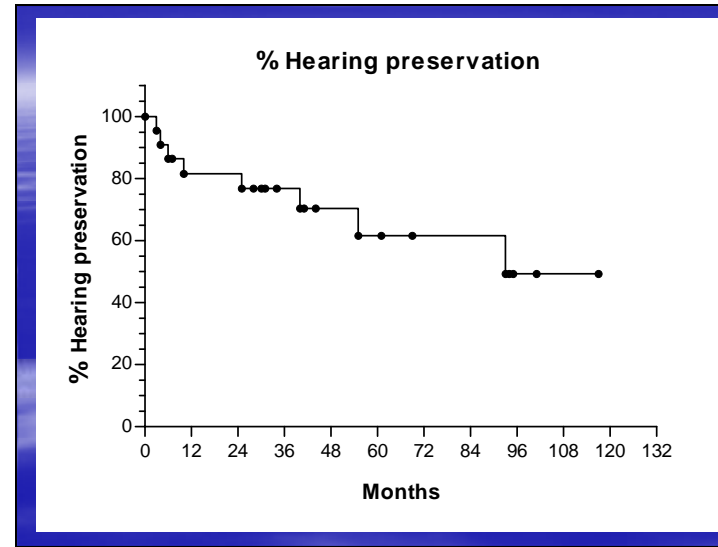
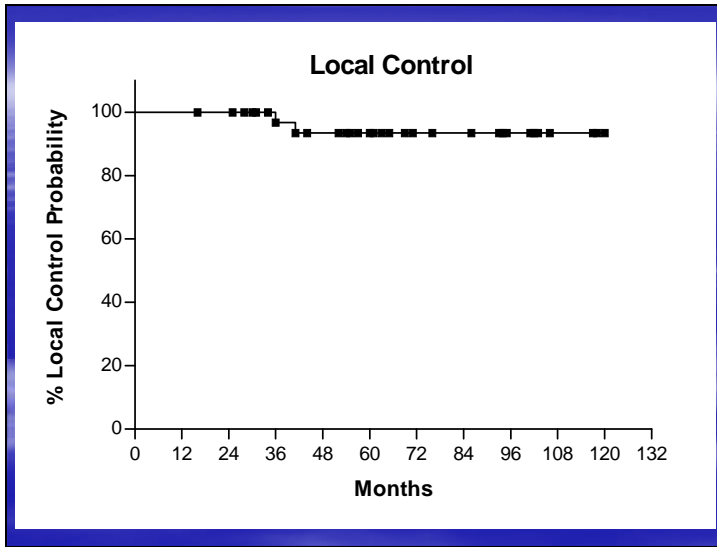
	Marita <i>et al.</i> Gamma Knife	Chang <i>et al.</i> Lin Acroel	Shafiq <i>et al.</i> Lin Acroel	Hobbs <i>et al.</i> Lin Acroel	Sabark <i>et al.</i> Gamma Knife	Tibbenha LABS Proton
No. of Patients	88	55	70	127	62	34
Range	2.3-30	0.45-27.6	0.6-28.6	0.16-51.2	0.8-56.8	2.6-78.9
Max dose	32 Gy	21.9 Gy	-	17.9 Gy	30 Gy	17.9 CGyE
Range	34-40 Gy	14.8-33.2 Gy	*	8.67-28 Gy	20-40 Gy	8.9-23.1 ab/CGyE
Range	12-20 Gy	12-15 Gy	10-20 Gy	9-20 Gy	11-20 Gy	7.8-18.2 ab/CGyE
Mean FU (months)	35	48.4	23	31	43	54
Range	13-83	17-81	3-88	1.5-79.8	13-101	3-177
Rad. stable	29.2%	97%	99%	50%	100%	-
smaller	68%	97%	99%	44%	100%	84.3%
bigger	2.3%	2%	-	13.7%	0%	0%
Clin. better	21.6%	27%	30%	0%	21%	50%
stable	-	62%	97%	8%	99%	47%
worse	-	7%	0%	0%	13%	9%

* not stated



- ### PATIENT CHARACTERISTICS
- Mean volume = 5.9 cc (0.2 – 45.7)
 - Mean ICRU reference dose = 16.1 SFE CGyE (13.3 SFECGyE => 90%)
 - Mean FU time = 6 years
 - Radiological control = 98 % 5 years
 - Hearing preservation = 42 %
 - Facial nerve preservation = 90 % 5 years
 - Mean age = 50 years

20



Author	RT modality	Dose prescribed	Fractions (no. of patients)	Mean tumor volume (cm ³)	Growth control (%) (years)	Nerve Preservation		
						Hearing (%) (years)	Facial (%) (years)	EMG (%) (years)
Weber et al. [26]	Proton therapy	12 CxGyE	Single (n = 88)	1.4 (median)	95 (5 yrs) actual CR	79 (2 yrs) 22 (5 yrs)	91 (5 yrs)	89 (5 yrs)
Wilkman [31]	Ligand-based	23 Gy	3 fractions (n = 412)	1.2	100	64	100	100
		30 Gy	10 fractions (n = 14)	8.1				
Mason et al. [33]	Ligand-based	10-13.5 Gy	Single (n = 19)	2.6	100 (5 yrs)	75 (5 yrs)	92 (5 yrs)	92 (5 yrs)
		20-25 Gy	5 fractions (n = 80)	2.8	94 (5 yrs)	61 (5 yrs)	97 (5 yrs)	98 (5 yrs)
Ivan et al. [34]	Gamma knife	12 Gy (margin)	Single (n = 31)	3.6 (median)	92 (5 yrs)	56 (5 yrs)	100 (5 yrs)	96 (5 yrs)
Unger et al. [35]	Gamma knife	13 Gy (margin)	Single (n = 86)	3.4 (median)	96	55	98	95
Bush et al. [27]	Proton therapy	54-60 CxGyE	30-33 fractions (n = 20)	4.3	100	31	100	100
Pons et al. [7]	IMRT	54 Gy	30 fractions (n = 8)	5.09 (2.48 median)	100	100	100	100
Laustont et al. [36]	Gamma knife	13 Gy (margin)	Single (n = 829)	1.2	97 (10 yrs)	80.77	99	97
Pfickinger et al. [37]	Gamma knife	13 Gy (margin)	Single (n = 313)	1.1	98.6 (6 yrs)	78.6 (6 yrs)	100 (6 yrs)	95.6 (6 yrs)
THIS SERIES	Proton therapy	21.4 CxGyE (margin) (13.3 CxGyE single fraction, 8.1 GyE)	3 fractions (n = 31)	5.9	98 (2 yrs) 98 (5 yrs)	74 (2 yrs) * 42 (5 yrs) *		96 (2 yrs) 93 (5 yrs)

CONCLUSION

- MAINLY RADIOSURGICAL CASES
- SIMILAR CLINICAL RESULTS COMPARED TO PHOTON SERIES
- DESPITE OF TREATING "LARGER" VOLUMES
- PROTON BEAM IS THEREFORE LIKELY A BETTER RADIOSURGICAL MODALITY FOR "LARGE" LESIONS
- NO CASES OF RADIATION INDUCED TUMORS WERE OBSERVED

24

THANK YOU

25