Aivometastaasit

Tekniset näkökohdat

Sädehoitopäivät 2014

Fyysikko Eeva Boman, TAYS
(el. Hanna Mäenpää, TAYS)

Aivometastaasin sädehoito

- WBRT (+booster)
- Kertahoito tai hypofraktiointi (SRS)
- WBRT+booster SIB
- Tervekudosrajoitteet
- Marginaali → Laiterajoitteet, tarkkuus
- Kuvantaohjaus (+ fiksaatio) → frameless
- VMAT vs. perinteisemmät
- Non-coplanaariset kentät –etua?
- Laskennassa huomioitavaa, pienet kohteet

CBCT tarkkuus

Medical Physics
The International Journal of Medical Physics Research and Practice

Accuracy and feasibility of cone-beam computed tomography for stereotactic radiosurgery setup

Jenghwa Chang[1,a)], Kamil M. Yenice[2], Ashwatha Narayana[3] and Philip H. Gutin[4]

Med. Phys. **34**, 2077 (2007); http://dx.doi.org/10.1118/1.2731031

Target #	E_x	E_y	E_z	$\|E\|$
1	−0.40	−0.42	−1.00	1.16
2	0.46	0.59	0.83	1.12
3	0.21	0.61	0.96	1.15
4	−1.52	−0.92	0.70	1.91
Avg	−0.32	−0.04	0.37	1.34
SD	0.76	0.66	0.80	0.33

TABLE IV.

Differences (in mm) of the translational corrections were determined from the CBCT scan and the orthogonal radiographs (Fig. 4). E_x , E_y , and E_z are differences in the x , y , and z directions, respectively.

Citation: Med. Phys. **34**, 2077 (2007); http://dx.doi.org/10.1118/1.2731031

- Geometrinen tarkkuus 0,28mm (vs.CT)
- Tarkkuus x ja y suuntaan ≈0.5mm
- Tarkkuus z-suuntaan ≈0.9mm (Leikepaksuus 2mm)

X_{av}=0.65/0,36mm
Y_{av}=0,64/0,54mm
Z_{av}=0,87/0,93mm

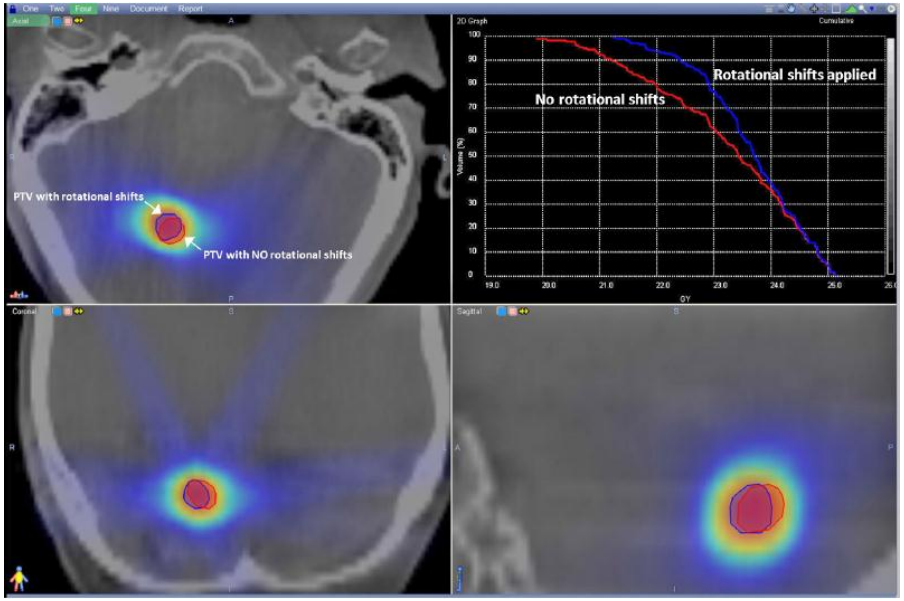
Tays

Kohdennus tarkkuus 6D pöytä

JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS, VOLUME 13, NUMBER 6, 2012

Six degrees of freedom CBCT-based positioning for intracranial targets treated with frameless stereotactic radiosurgery

Anees Dhabaan,[a] Eduard Schreibmann, Arsalan Siddiqi, Eric Elder, Tim Fox, Tomi Ogunleye, Natia Esiashvili, Walter Curran, Ian Crocker, and Hui-Kuo Shu



- 6D pöytä lisää hoidon tarkkuutta
- Virhe Lat 0.2 mm, Vrt 0.3 mm, and Long 0.4 mm
- Pitkittäis 0.1°, sivuttais 0.2°, kierto 0.1°
- Maskifiksaatio olisi riittävä

Hoidon tarkkuus

- Säteilyisosentrin tarkkuus, esim. TrueBeam STx

4.0 Isocenter Specifications

All scale references below are per IEC 61217

Performance Specifications	Specification
Gantry and collimator isocenter accuracy	≤ 0.5 mm radius
Gantry, collimator, and couch isocenter accuracy	≤ 0.75 mm radius

CAP mittaukset → isosentrin säde 0,29mm/0,71mm

- Asettelu tarkkuus → jos kuvantaohjauksen tarkkuus ≈0,5mm

→ Näistä aiheutuva marginaali hoidon osuvuudelle 0,6mm/0,9mm

Frameless SRS

- Hyvä fiksaatio maski, kohdennus kuvantaohjauksella
- Minniti et al → 1mm marginaali riittävä

Minniti *et al. Radiation Oncology* 2011, 6:158

Frameless linac-based stereotactic radiosurgery (SRS) for brain metastases: analysis of patient repositioning using a mask fixation system and clinical outcomes

Giuseppe Minniti[1,2*], Claudia Scaringi[1], Enrico Clarke[1], Maurizio Valeriani[1], Mattia Osti[1] and Riccardo Maurizi Enrici[1]

Abstract

Purpose: To assess the accuracy of patient repositioning and clinical outcomes of frameless stereotactic radiosurgery (SRS) for brain metastases using a stereotactic mask fixation system.

Patients and Methods: One hundred two patients treated consecutively with frameless SRS as primary treatment at University of Rome Sapienza Sant'Andrea Hospital between October 2008 and April 2010 and followed prospectively were involved in the study. A commercial stereotactic mask fixation system (BrainLab) was used for patient immobilization. A computerized tomography (CT) scan obtained immediately before SRS was used to evaluate the accuracy of patient repositioning in the mask by comparing the isocenter position to the isocenter position established in the planning CT. Deviations of isocenter coordinates in each direction and 3D displacement were calculated. Overall survival, brain control, and local control were estimated using the Kaplan-Meier method calculated from the time of SRS.

Results: The mean measured isocenter displacements were 0.12 mm (SD 0.35 mm) in the lateral direction, 0.2 mm (SD 0.4 mm) in the anteroposterior, and 0.4 mm (SD 0.6 mm) in craniocaudal direction. The maximum displacement of 2.1 mm was seen in craniocaudal direction. The mean 3D displacement was 0.5 mm (SD 0.7 mm), being maximum 2.9 mm. The median survival was 15.5 months, and 1-year and 2-year survival rates were 58% and 24%, respectively. Nine patients recurred locally after SRS, with 1-year and 2-year local control rates of 91% and 82%, respectively. Stable extracranial disease ($P = 0.001$) and KPS > 70 ($P = 0.01$) were independent predictors of survival.

Conclusions: Frameless SRS is an effective treatment in the management of patients with brain metastases. The presented non-invasive mask-based fixation stereotactic system is associated with a high degree of patient repositioning accuracy; however, a careful evaluation is essential since occasional errors up to 3 mm may occur.

Keywords: stereotactic radiosurgery, positioning reproducibility, isocenter verification, brain metastases

Annosjakauman ominaisuuksia

Medical Physics
The International Journal of Medical Physics Research and Practice

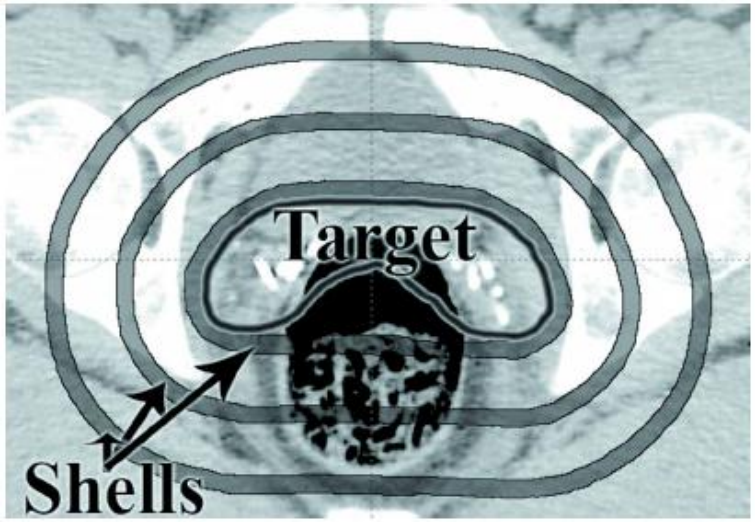
Integral dose conservation in radiotherapy

Adam S. Reese, Shiva K. Das, Charles Curle, and Lawrence B. Marks

Citation: Medical Physics **36**, 734 (2009); doi: 10.1118/1.3070585

- Hypothesis 1: For a particular patient data set and a particular beam configuration, the normalized integral dose to any two shells of normal tissue (surrounding the target) is approximately equal.
- Hypothesis 2: For a particular patient data set and a particular shell of normal tissue within that data set, the normalized integral dose to the shell is approximately constant for different beam configurations.
- Hypothesis 3: For a particular patient data set and a particular shell of normal tissue within that data set, the normalized integral dose to the shell is approximately constant as the dose to a critical structure is reduced (keeping target dose constant).

If these assumptions are true, they imply that modern delivery methods are able to *redistribute* dose within shells and are unable to transfer dose *between* shells.



- Integraaliannos kussakin ringissä ≈vakio
- Jos johonkin haluaa jyrkän gradientin, on toisessa suunnassa annosta nostettava
- Miten annosjyrkkyyteen voi vaikuttaa, jos halutaan joka puolelle mahdollisimman jyrkkä gradientti?
  - Koneen ominaisuudet, penumbra
  - → kenttäkoko, MLC
  - Non-coplanaariset kentät

Tays

MLC:n koko

→ 2,5mm MLC parempi konformaalisuus, pienempi normaalikudos annos, jyrkempi annos gradientti

The British Journal of Radiology, 84 (2011), 629–638

Impact of the high-definition multileaf collimator on linear accelerator-based intracranial stereotactic radiosurgery

[1,2]J A TANYI, PhD, [3]C M KATO, [4]Y CHEN, PhD, [5]Z CHEN, MS and [1]M FUSS, MD, PhD

Objectives: The impact of two multileaf collimator (MLC) systems for linear accelerator-based intracranial stereotactic radiosurgery (SRS) was assessed.
Methods: 68 lesions formed the basis of this study. 2.5 mm leaf width plans served as reference. Comparative plans, with identical planning parameters, were based on a 5 mm leaf width MLC system. Two collimation strategies, with collimation fixed at 0° or 90° and optimised per arc or beam, were also assessed. Dose computation was based on the pencil beam algorithm with allowance for tissue heterogeneity. Plan normalisation was such that 100% of the prescription dose covered 95% of the planning target volume. Plan evaluation was based on target coverage and normal tissue avoidance criteria.
Results: The median conformity index difference between the MLC systems ranged between 0.8% and 14.2%; the 2.5 mm MLC exhibited better dose conformation. The median reduction of normal tissue exposed to ⩾100%, ⩾50% and ⩾25% of the prescription dose ranged from 13.4% to 29.7%, favouring the 2.5 mm MLC system. Dose fall-off was steeper for the 2.5 mm MLC system with an overall median absolute difference ranging from 0.4 to 1.2 mm. The use of collimation optimisation resulted in a decrease in differences between the MLC systems. The results demonstrated the dosimetric merit of the 2.5 mm leaf width MLC system over the 5 mm leaf width system, albeit small, for the investigated range of intracranial SRS targets.
Conclusion: The clinical significance of these results warrants further investigation to determine whether the observed dosimetric advantages translate into outcome improvements.

5mm vs. 2.5mm
→Transmissio
→ Modulointi

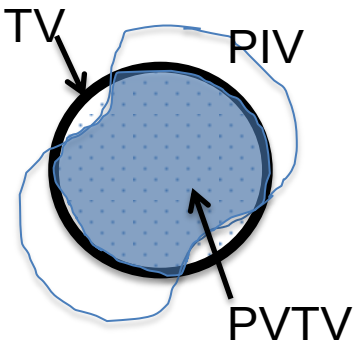
Laitteiden vertailua

Int. J. Radiation Oncology Biol. Phys., Vol. 73, No. 2, pp. 562–570, 2009

CONFORMITY OF LINAC-BASED STEREOTACTIC RADIOSURGERY USING DYNAMIC CONFORMAL ARCS AND MICRO-MULTILEAF COLLIMATOR

LISA J. HAZARD, M.D. et.al

			Size (cm^3)		CI		PITV ratio	
Investigator	Technique (*n*)	Prescription IDS (%)	Mean	Median	Mean	Median	Mean	Median
Nedzi *et al.*, 1993 (14)	LINAC, actual* (43)	80	NR	5.7	NR	NR	NR	2.7
	LINAC, ideal* (43)	80	NR	5.7	NR	NR	NR	1.89
Kubo *et al.*, 1997 (19)	Fixed-field LINAC mMLC (12)	Median 82.5	NR	NR	NR	NR	1.85	1.80
Ma *et al.*, 1999 (25)	IMRS (3)	Encompassed tumor†	11	11	NR	NR	1.96	1.99
	GK (3)	Encompassed tumor†	11	11	NR	NR	2.2	2.42
Baumert *et al.*, 2001 (16)	Fixed-field LINAC (7)	95	16.83	17.6	NR	NR	1.5	1.5
	Proton (7)	95	16.83	17.6	NR	NR	1.2	1.17
Nakamura *et al.*, 2001 (2)	GK (1,338)	Median 50	1.8	NR	NR	1.78	NR	1.67
Nakamura *et al.*, 2003 (23)	IMRS (10)	Mean 75	9.3	NR	1.36	NR	1.25	NR
	GK (10)	Mean 50.5	9.3	NR	1.73	NR	1.53	1.56
	Fixed-field proton (6)	95	29.5	30	0.86‡	0.86‡	1.04	1.01
	Fixed-field IMPT (6)	95	29.5	30	0.85‡	0.85‡	1.03	1.03
Lomax *et al.*, 2003 (22)	GK (551)	50	NR	NR	0.69§	NR	1.24	NR
Kuo *et al.*, 2004 (20)	GK, Model U (96)	Median 50	4.8	4.1	NR	NR	1.7	1.6
	GK, Model C (45)	Median 50	4.3	3.0	NR	NR	1.6	1.5
Andrews *et al.*, 2004 (7)	LINAC a (55)¶	Median 85	20.7	3.3	NR	NR	NR	1.9
	LINAC b (20)¶	Median 85	120.4	4.1	NR	NR	NR	1.7
	LINAC c (10)¶	Median 80	16.39	1.3	NR	NR	NR	2.1
	GK a (27)¶	Median 50	20.7	3.3	NR	NR	NR	1.4
	GK b (6)¶	Median 50	120.4	4.1	NR	NR	NR	1.5
	GK c (1)¶	Median 51.5	16.39	1.3	NR	NR	NR	2.0
Collins *et al.*, 2006 (17)	CyberK Simple‖ (36)	Encompasses tumor†	45.61	8.83	1.66	1.57	NR	NR
	CyberK Mets (43)	Encompasses tumor†	4.87	1.43	1.73	1.64	NR	NR
	CyberK Complex‖ (46)	Encompasses tumor†	12.6	7.27	1.67	1.57	NR	NR
Han *et al.*, 2006 (18)	Noncoplanar IMRS (16)	NR	14.65	NR	1.53	1.35	1.36	NR
	Coplanar IMRS (16)	NR	14.65	NR	1.35	1.33	1.23	NR
	Tomo (16)	NR	14.65	NR	1.26	1.27	1.15	NR
Lindquist *et al.*, 2007 (21)	GK, Model B (100)	NR	4.4	NR	0.81#	NR	1.14	NR
	GK, Model C (44	NR	5.5	NR	0.80#	NR	1.20	NR
	GK, Model Perfexion (22)	NR	5.0	NR	0.86#	NR	1.07	NR
Present series	LINAC, actual# (184)	Median 82	4.60	2.54	1.85	1.61	1.79	1.56
	LINAC, standardized# (184)	Median 86	4.60	2.54	1.54	1.47	1.41	1.34



TV = PTV vol
PIV = halutun annoksen vol
PVTV haluttu annos PTVssä

Konformaalisuus indeksi

$$CI = \frac{PIV/PVTV}{PVTV/TV}$$

RTOG indeksi

$$PITV\text{ratio} = \frac{PIV}{TV}$$

Tays

CK parempi kauempana PTVstä

J. Radiation Oncology ● Biology ● Physics Volume 81, Number 2, Supplement, 2011

3385 Comparison of Brain SRS Treatment Plan Quality of CyberKnife and RapidArc

A. T. Lo

Purpose/Objective(s): This work will evaluate the quality of brain SRS (stereotactic radiosurgery) treatment plan of CyberKnife from Accuray and RapidArc from Varian. CyberKnife is a cone based non-isocentric SRS system with 6MV X-ray, it can generate arbitrary dose shape with high conformality and rapid dose fall off. RapidArc is a MLC based volumetric modulated arc therapy system, it can potentially deliver dose shape typically required for brain SRS with 2.5mm HD MLC. This study will compare quality of treatment plans using RapidArc with treatment plans using CyberKnife for acoustic neuroma.

Materials/Methods: Clinical CyberKnife treatment plans for acoustic neuroma with target volumes between 1 and 4 cc (cubic centimeter) are selected to be re-planned using RapidArc with 6MV X-ray. Prescription is 18 Gy in 3 fractions covering at least 95% of the target volume while keeping minimum doses to brainstem and cochlea. The RapidArc plans are generated to have the same target coverage and dose constraints. CI (conformity index), $CI_{50\%}$ (ratio of volume getting 50% prescription dose to volume at prescription), V_8 (volume of brainstem getting more than 8 Gy), cochlea mean dose and maximum dose at 2cm from target are compared between the 2 modalities.

Results: CyberKnife plans are consistently superior to RapidArc plans. The RapidArc plans on average have 10% higher CI, 70% higher $CI_{50\%}$, 50% more volume of brainstem getting more than 8 Gy, 15% higher cochlea mean dose and 45% higher maximum dose 2cm from targets than CyberKnife plans with same target coverage and similar target minimum.

Conclusions: For small brain lesions such as acoustic neuroma, RapidArc can generate plans with similar conformality to the target but with slower dose fall as well as higher dose to brainstem and cochlea than CyberKnife.

Conformity Index and Dose Fall Off

CyberKnife CI	RapidArc CI	CyberKnife CI 50%	RapidArc CI 50%
1.37	1.35	2.27	5.28
1.19	1.31	4.40	6.03
1.07	1.30	2.71	4.90
1.26	1.50	2.92	4.97
1.17	1.35	2.54	4.50
1.11	1.16	2.58	5.45
1.32	1.42	2.67	5.30
1.12	1.18	3.75	4.75

- CI voi olla samaa luokkaa, mutta CI 50% CKn eduksi reilusti
- Ei selviä oliko VMAT kaaret non-coplanaarisia

Mikä tekniikka?

Clinical Oncology (2009) **21**: 408–416

Does Intensity-modulated Stereotactic Radiotherapy Achieve Superior Target Conformity than Conventional Stereotactic Radiotherapy in Different Intracranial Tumours?

S. D. Sharma*, R. Jalali†, R. D. Phurailatpam‡, T. Gupta‡

Int. J. Radiation Oncology Biol. Phys., Vol. 76, No. 1, pp. 296–302, 2010

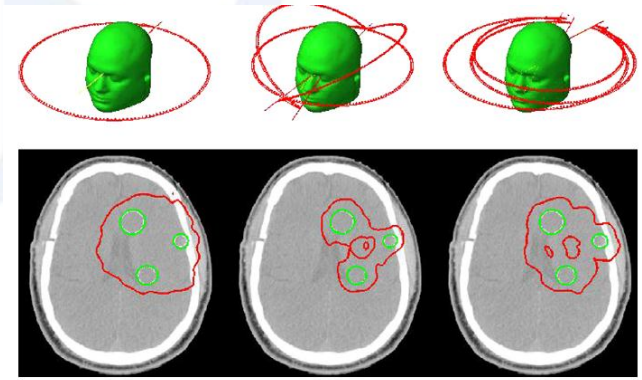
FEASIBILITY OF SINGLE-ISOCENTER VOLUMETRIC MODULATED ARC RADIOSURGERY FOR TREATMENT OF MULTIPLE BRAIN METASTASES

GRANT M. CLARK, M.D.,*† RICHARD A. POPPLE, PH.D.,* P. EDWARD YOUNG, M.S.,* AND JOHN B. FIVEASH, M.D.*

SU-E-T-561: Multiple RapidArc-Based Radiosurgery for Intracranial Tumors: Comparison with Conventional Dynamic Conformal Arc Technique

Y Yang[1], B Zhao[1], X Li[1], T Li[1], D Heron[1] and M Huq[1]

Med. Phys. **38**, 3618 (2011)



Sharma 2009: IMRT parempi vs. VMAT + non-coplanaarisista hyötyä IMRT suunn.

(CI 1,21 vs. 1,39)

Clark 2010: Usea PTV

→ yksi isosentri VMAT

→ Aika säästö + non-coplanaarisista hyötyä

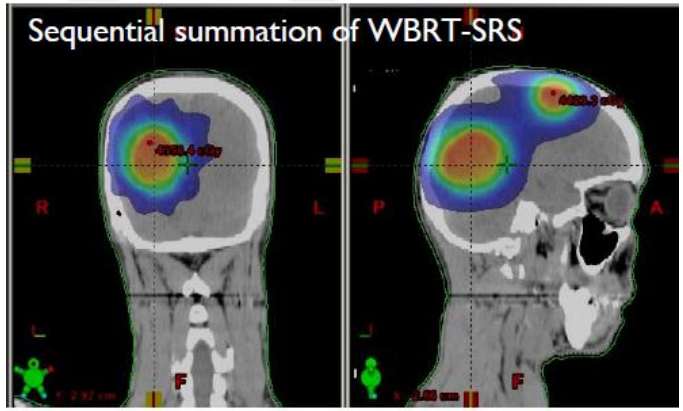
Yang 2011: Usean non-coplanaarisen kaaren suunnitelma parempi kuin yksi kaari tai konformaalinen kaari

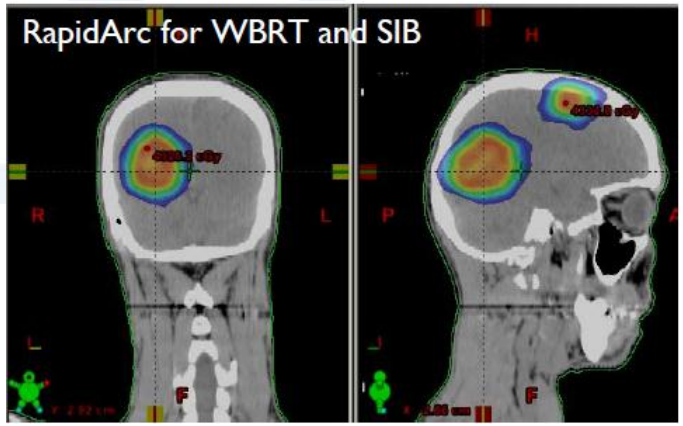
Wang et al. SU-GG-T-530 2011 (posteri): 5 non-coplanaarista kaarta parempi kuin 1 kaari usean kohteen suunnitelmassa

(esim. CI 1.38 vs. 1.82)

WBRT+boost SIB? (5x4Gy/8Gy)

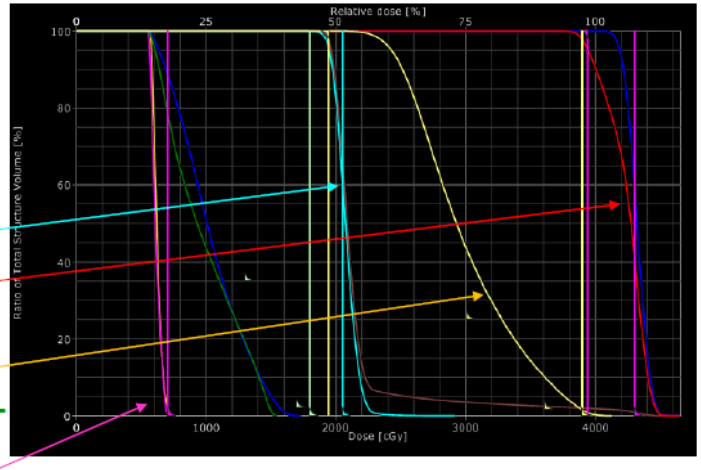
2 VMAT kaarta
Annosgradientti aivojen ulkopuolella paranee
Hoitokerrat ja hoitoaika ↓





VUmc WBRT + SIB for brain mets

RapidArc optimization



Constraints on

- WBRT-ring-boost
- Boost PTVs
- Ring around boost
- Ring around WBRT
- Eye lens < 7 Gy
- WBRT-ring-boost V_{22Gy} < 10%
- Boost dose 38 - 45 Gy (95%-114%)

(http://www.aapm.org/meetings/amos2/pdf/49-14571-58212-409.pdf)

Tays

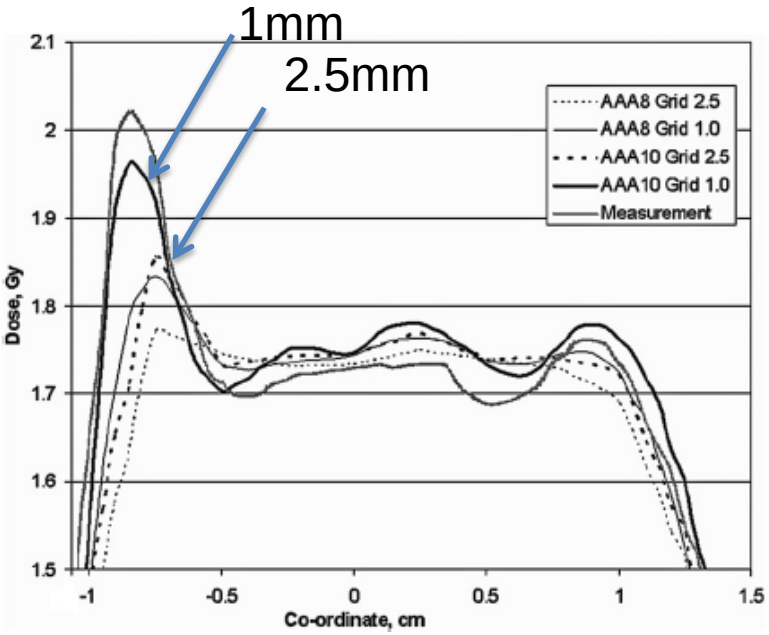
Annoslaskennan tarkkuus,
AAA hilakoko

Medical Physics
The International Journal of Medical Physics Research and Practice

Impact of the calculation resolution of AAA for small fields and RapidArc treatment plans

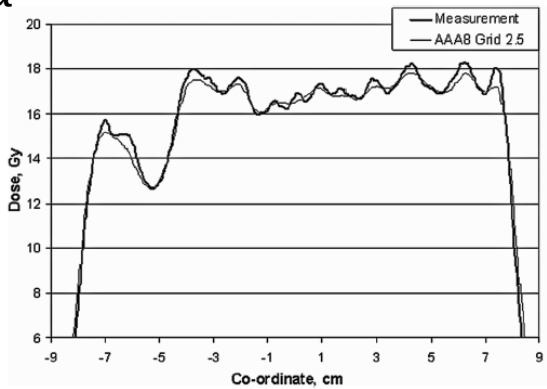
Chin Loon Ong, Johan P. Cuijpers, Suresh Senan, Ben J. Slotman, and Wilko F. A. R. Verbakel

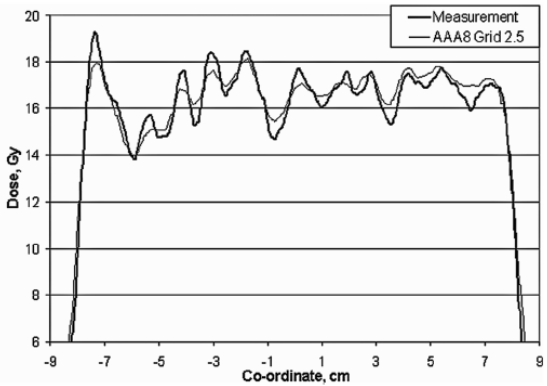
Citation: Medical Physics **38**, 4471 (2011); doi: 10.1118/1.3605468



Ong 2011:

- Annoslaskenta tiheällä 1mm hilalla
- vähemmän modulointia (MU määrä/Gy)
- Virhe korostuu pienissä kohteissa pienillä marginaaleilla suurilla annoksilla





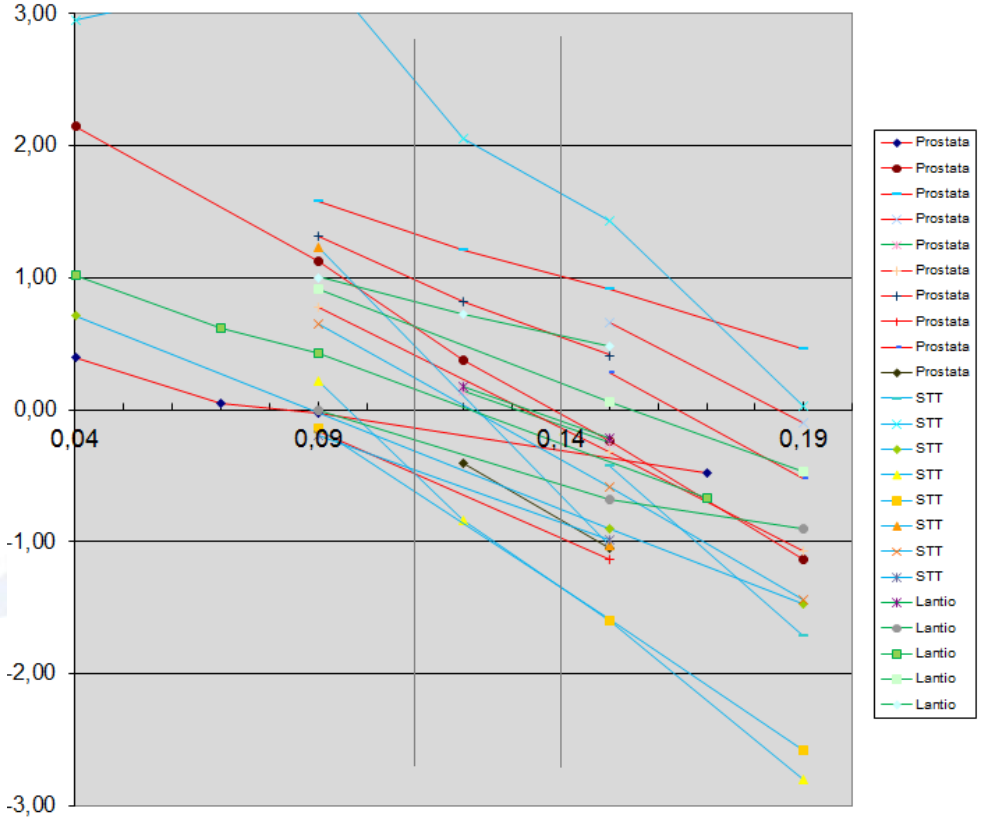
Annoslaskennan tarkkuus, DLG

Medical Physics
The International Journal of Medical Physics Research and Practice

Verification of dosimetric accuracy on the TrueBeam STx: Rounded leaf effect of the high definition MLC

Kayla N. Kielar[1,a)], Ed Mok[1], Annie Hsu[1], Lei Wang[1] and Gary Luxton[1]

Med. Phys. **39**, 6360 (2012);



Kielar 2012: DLG potilassuunnitelmia mittaamalla

- 5% annosvirhe mahdollista
- Kenttäkoon vaikutus DLG parametriin

Tays

Potilasesimerkki

Potilaan esitiedot:

67-vuotias mies, jolla pitkä tupakkahistoria. Somac ja Orloc käytössä. 1998 poistettu oikean keuhkon ylä-ja keskilohko adenokarsinooman vuoksi.

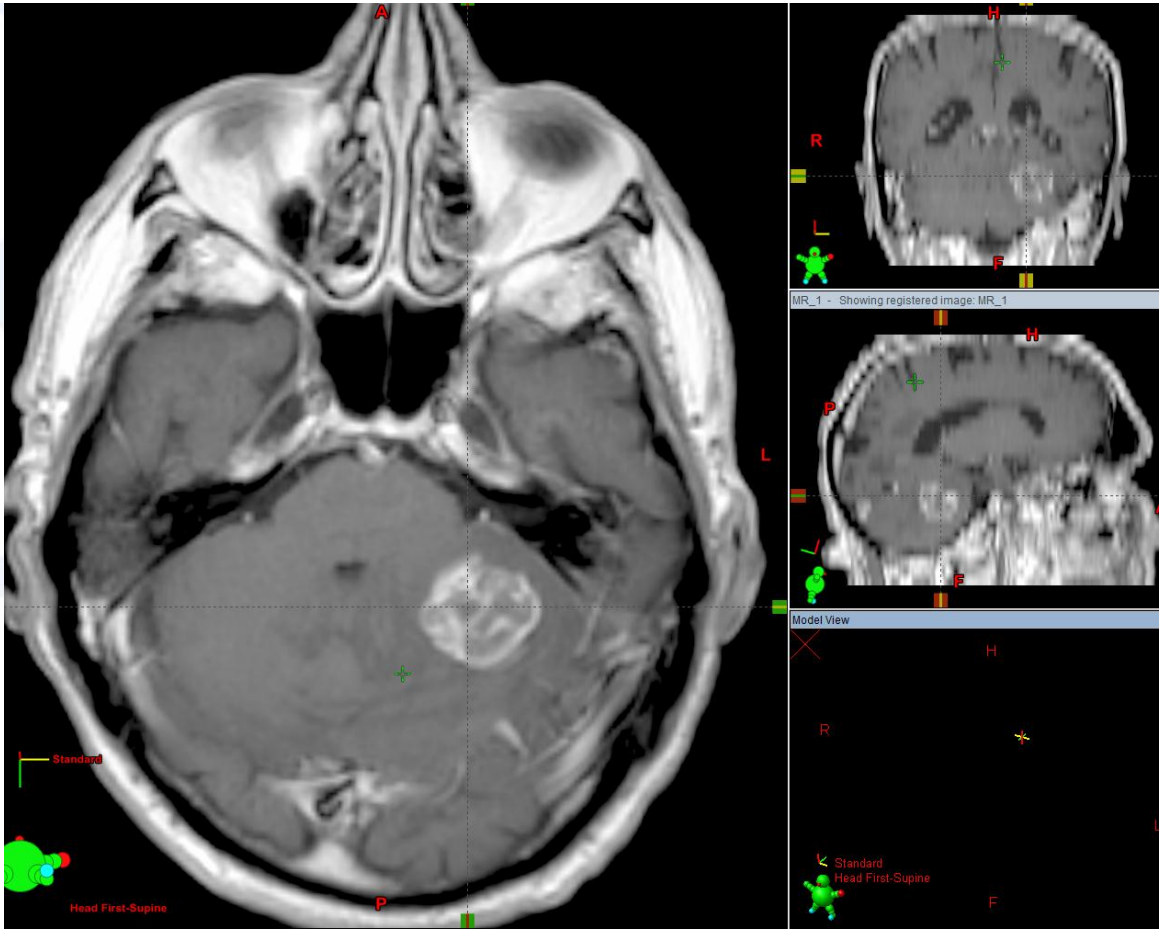
Kesällä 2012 laihtumisen vuoksi tehdyissä tutkimuksissa löytyi vasemman keuhkon alalohkon T2aN0M0 epidermoidikarsinooma →stereotaktinen sädehoito 5x11 Gy 8/2012.

Hoitovaste keuhkotuumorin oli hyvä vartalon ct-kuvauksessa 9/2013, arpimainen muutos näkyvissä. Ei uutta maligniin viittaavaa ct:ssa. Kontrollikäynnillä kertoi, että 1kk sitten oli alkanut päänsärky ja 2vk oli ollut myös huimausta ja oksentelua. Ei pareesioireita. Kävely hieman epävarmaa. Z=2.

Epäiltiin aivometastasointia ja aivojen MRI:ssä näkyikin metastaasiksi sopiva muutos. Dexametasonin aloituksen myötä oireet lievittyivät nopeasti. Potilas oli omatoiminen, orientoitunut ja liikkui ilman apuvälineitä.

MRI

Takakuopassa vasemmalla pikkuaivohemisfäärissä on TT-kuvia vastaten 2,6 x 2,2 cm kokoinen heterogeenisesti tehostuva tuumori metastaasiksi sopien. Tuumorin ympärillä on voimakas ödeema ja tuumori on ekspansiivinen, akvedukti ja IV ventrikkeli näkyvät kuitenkin avoimina. Muita metastaasisuspekteja muutoksia ei näy.



Kysely

- Potilastapauskysely lähetettiin Suomen sädehoitokeskuksiin (12)
- Vastaukset saatiin 10 paikasta
- 7-8 hoitaisi itse, 3-4 lähettäisi yliopistolliseen keskukseen
- Lisätietoja, joita olisi haluttu:
  - Onko aikaisemmin aivometastaasihoitoja?
  - Mikä on potilaan kunto? Onko aloitettu kortisonilääkitys?
  - yleistila, onko Z 2 vain aivo-oireista vai muutakin?
  - neurokirurgin lausunto, leikkauskelpoisuus?
  - aiempia sytostaatteja? Dexametasonvaste?
  - PAD?

Tays

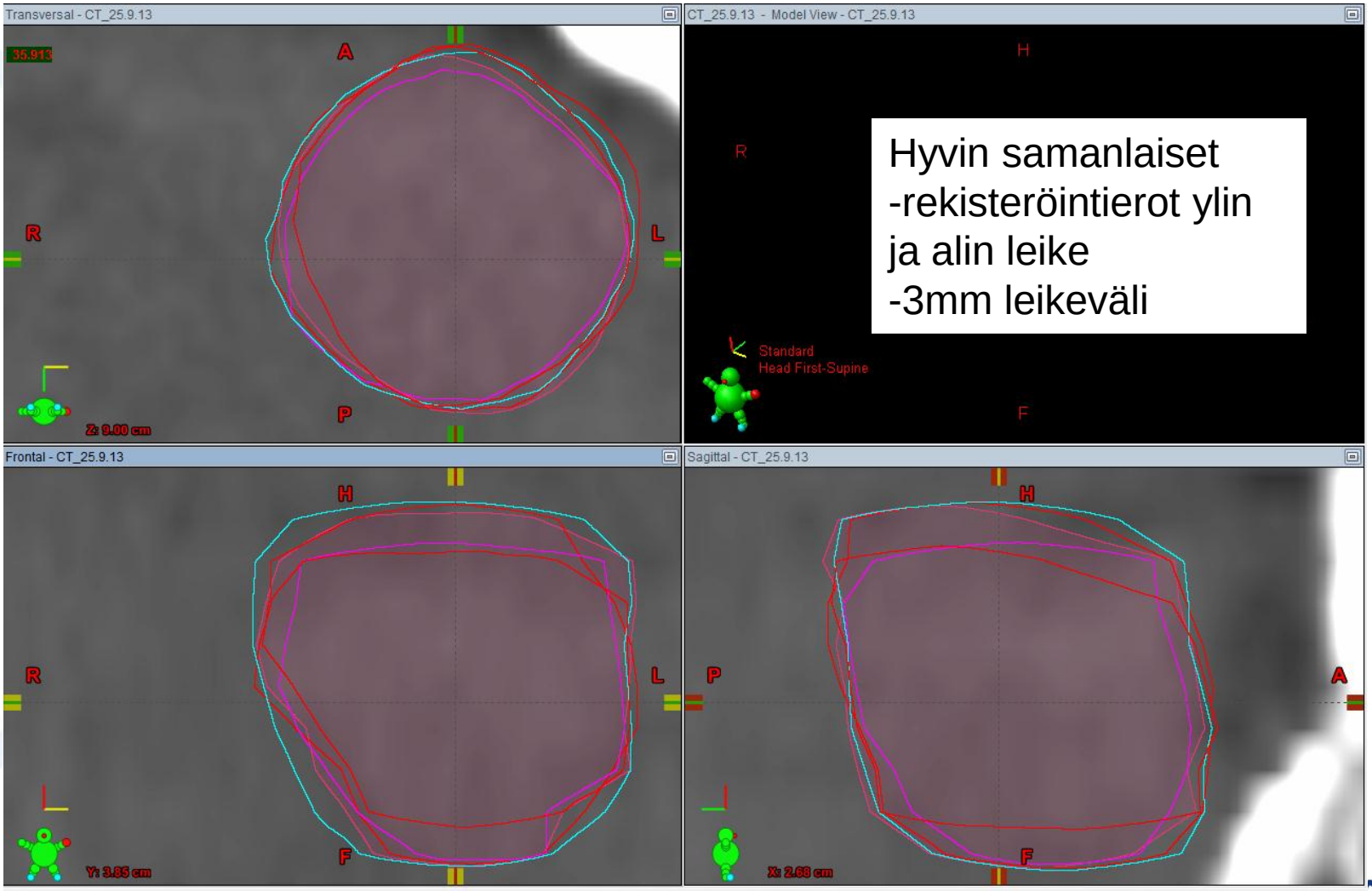
Annosmääritys

Yks.	Annos	GTVvol (cm3)	PTVvol (cm3)	marg (mm)
1	3x9Gy*	10,2	14,0	1
2	5x6Gy*	11,4	18.7	2
3	15x3Gy	7,9	25,3	6
4	3x5Gy*+WBRT	10,1	19,2	3
5	5x3Gy+WBRT	7,8	63,7	12
6	10x2Gy+WBRT	10,1	55,1	12
7	3x3Gy+WBRT Tai 2x7.5Gy			4-5
8	WBRT			

- * 3fr/vk
- Kokoaivot WBRT 10x3Gy

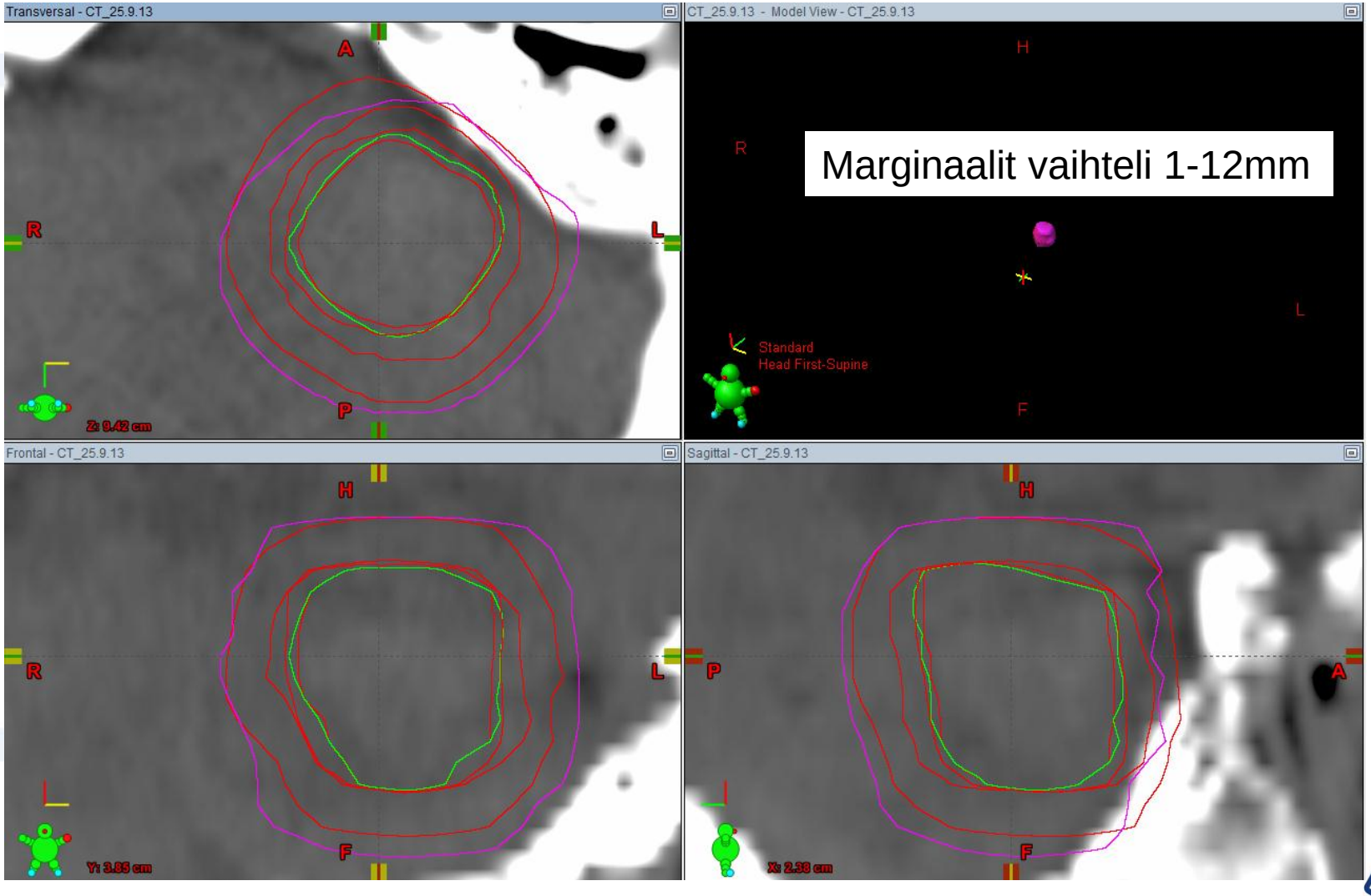
Tays

GTV



Hyvin samanlaiset
-rekisteröintierot ylin ja alin leike
-3mm leikeväli

PTV


Transversal - CT_25.9.13
A
R
L
P
Z: 9.42 cm
CT_25.9.13 - Model View - CT_25.9.13
H
R
L
F
Standard
Head First-Supine
Marginaalit vaihteli 1-12mm
Frontal - CT_25.9.13
H
R
L
F
Y: 3.86 cm
Sagittal - CT_25.9.13
H
P
A
F
X: 2.38 cm

Annosnormeeraus

- Kokoaivot
  - PTVmean, min ≥ 90%, max < 110%
- Metastaasi

yksikkö	Annos	Normitus PTV	Min > (%)	Max < (%)
1	3x9Gy	D100/V95%	95	140
2	5x6Gy	Mean	95	107
3	15x3Gy	Mean	95	106
4	3x5Gy+WBRT	D100/V95%	95	130-150
5	5x3Gy+WBRT	Mean	95	107
6	10x2Gy+WBRT	100%	D95%>95 D99%>93	107

Tays

Kriittiset elimet, jotka huomioitu suunnittelussa ja niiden annosrajat

Kokoaivot

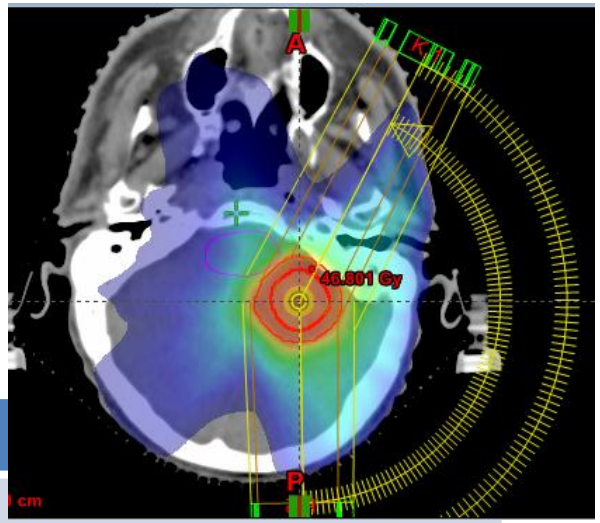
- Linssit <5Gy

yksikkö	Annos	Rajoitteet	Toteutuma (max)
1	3x9Gy	Aivorunko Dmax<18Gy Sisäkorva Dmax<18Gy Aivot-GTV V24<16cc	+3mm 12.1Gy 11.9Gy V24=10.7cc
2	5x6Gy	*Aivorunko < 25 Gy* *Sisäkorva < 27 Gy*	15.6Gy 18.5Gy
3	15x3Gy+WBRT	Aivorunko <40Gy Sisäkorva <40Gy	37.1Gy 35.5
4	3x5Gy+WBRT	Aivorunko 50 – 55 Gy (α/β = 2 Gy) Medulla oblongata 48 – 50 Gy Sisäkorva huomioitu, ei rajaa	9.3Gy (+30Gy) 4.8Gy 7.1Gy
5	5x3Gy+WBRT	Aivorunko max 55Gy (EQD2) Sisäkorva max 54Gy (EQD2)	13.5Gy (+30Gy) 11.2Gy
6	10x2Gy+WBRT PTV tingitty aivorunko+3mm	Aivorunko max. 50Gy (EQD2) Aivorunko+3mm $D_{Eq2Gy,\ tot}$ = 54Gy. Medulla max. 42 Gy, jos sytost. (EQD2) tai BED < 120 Gy (a/b = 2)	14.9Gy (+30Gy) Sisäkorva 13.7Gy

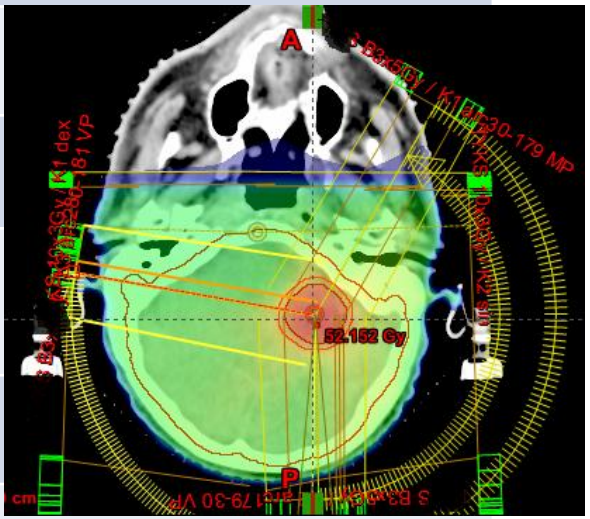
Hoitotekniikka

Kokoaivo 2 vast., annoslaskenta 2-2.5mm hila

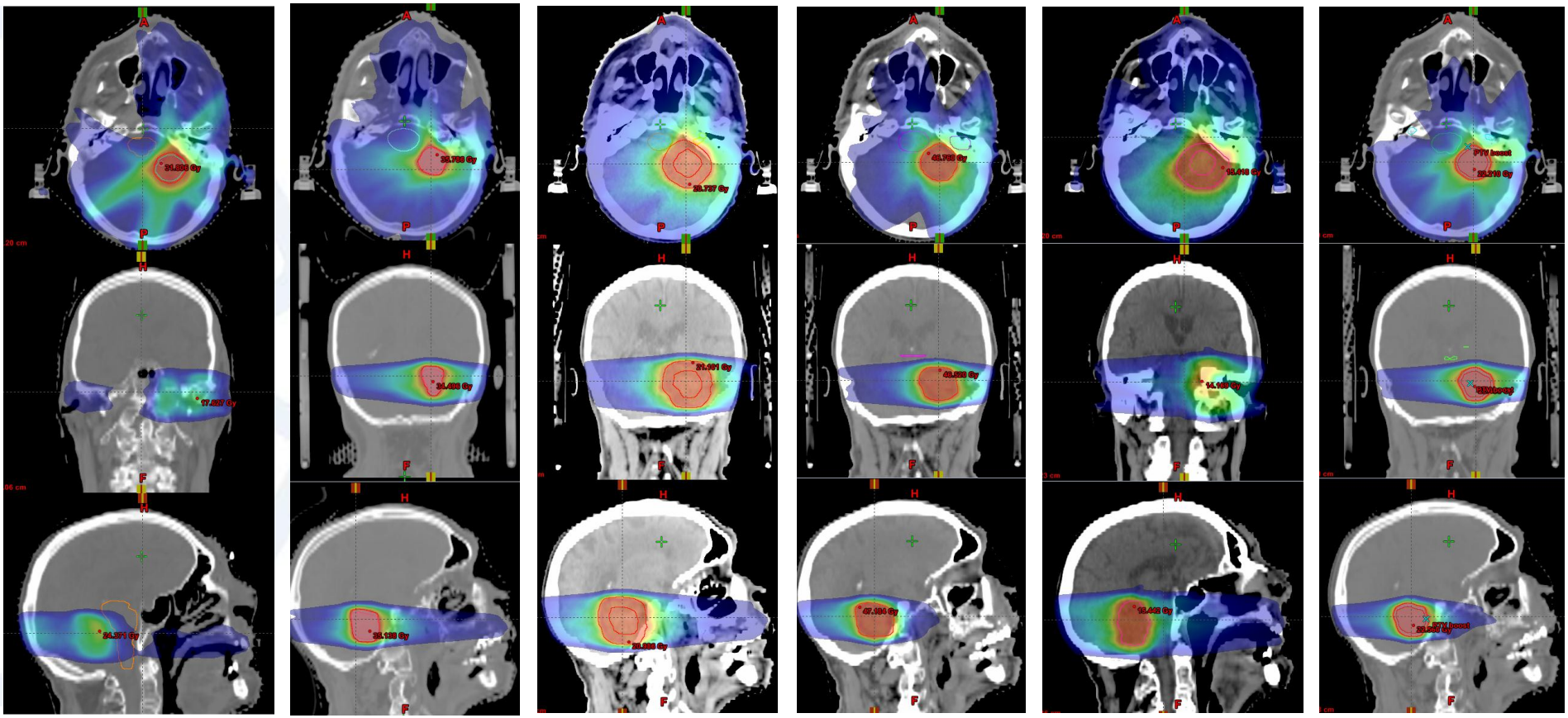
6MV



yksikkö	Kone	Kentät	Laskenta
1	Varian TrueBeam	VMAT 2 kaarta	AAA 2.5mm
2	Elekta Infinity	VMAT 1 kaari	MC 2,5mm 1% tarkkuus
3	Varian TrueBeam	VMAT 2 (1/3)-kaarta	AAA 2,5mm
4	Novalis Tx, 6D pöytä	VMAT 3 (1/3)-kaarta	AAA 1mm
5	Varian iX	VMAT 2 kaarta	AAA 2,5mm
6	Varian TrueBeam	VMAT 2 kaarta + (1/3)-kaari	AAA 2,5mm

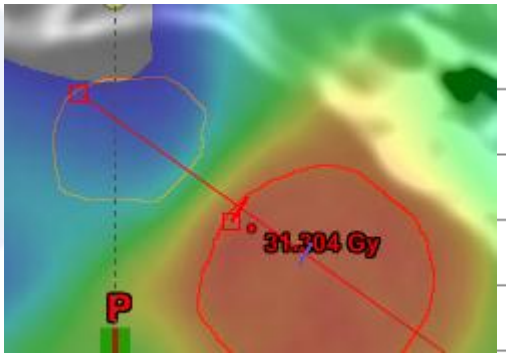


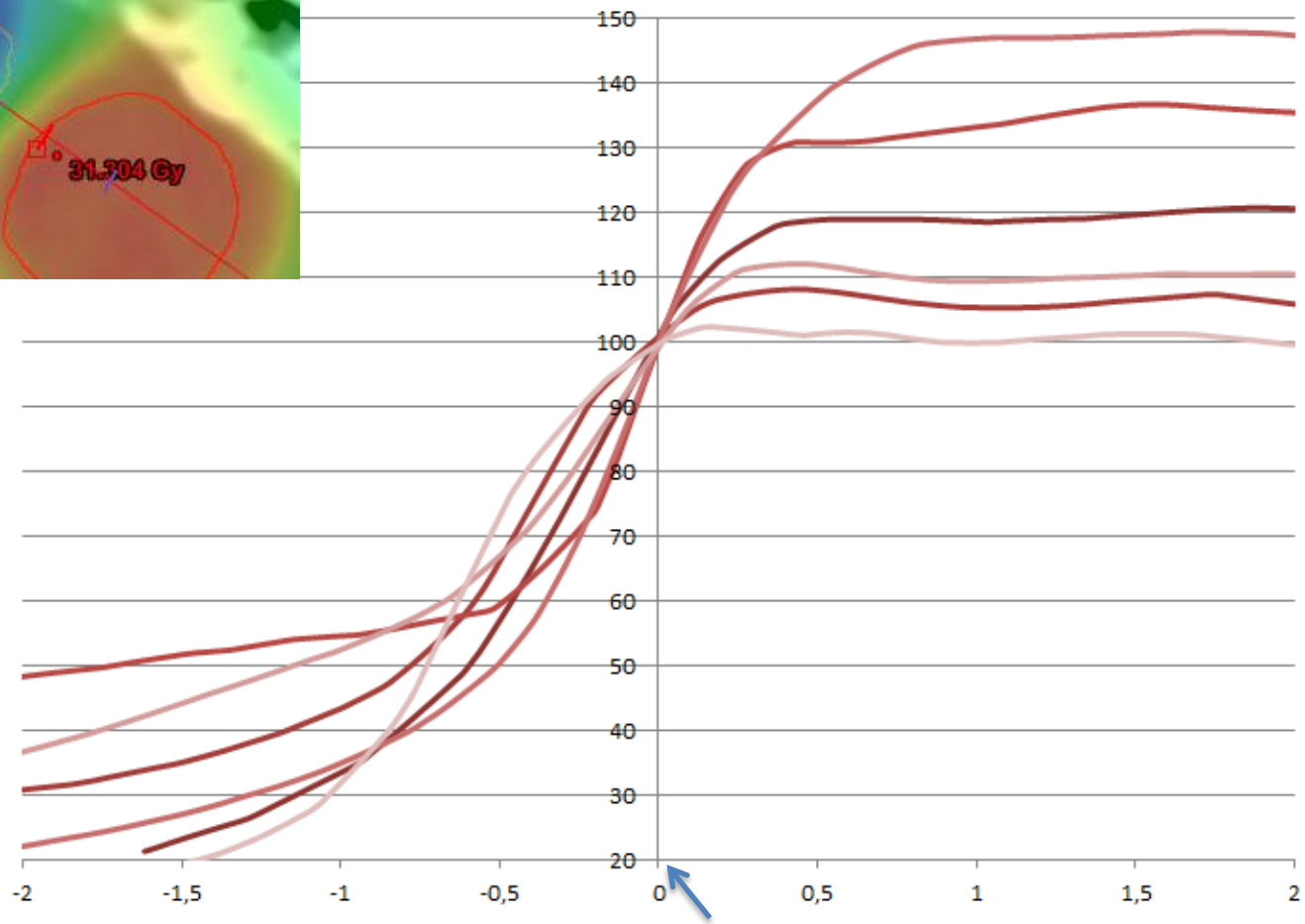
Annosjakaumat



Väriskaala 105% -- 10% hoitoannoksesta

Annosgradientti aivorunkoon





PTVn reuna

Vastaako esimerkkitapaus teillä hoidettuja

- Kyllä vastaa. x4
- Kyllä vastaa, paitsi että olisi hoidettu eri laitteella (tekniset syyt).
- Eipä juurikaan. Usein metastaasi operoitu ja sädehoito tulee postoperatiivisesti koko aivoihin. Tuumoripetiin voidaan antaa lievä boost, normaalisti 3 x 3,0 Gy.
- Harvinainen.

Kuinka paljon oligomet.hoitoja 2013

- Aivojen SRS metastaasihoitoja 7kpl
- Aivojen SRS metastaasihoitoja 4 potilasta (5 kohdetta)
  - Näistä 1 edellä esitetyn kaltainen
  - Muut potilaat olivat saaneet aikaisemmin koko aivojen sädehoidon ja stereotaktinen hoito oli uusintahoito.
  - Tilastoja postoperaativisen koko aivojen (+lievä boost) sädehoidon saaneista oligometastaasipotilaista ei ole saatavilla.
- Stereotaktisesti vuodessa hoidetaan noin 10 kpl.
- Ei tietoa, ei tilastoitu erikseen.
- Vähän

Tays

Suunnitteluun ja piirtoon käytetty aika

- Lääkäri 1h, fyysikko 1,5h
- Piirto 30min ja annossuunnittelu noin 1,5h
- GTV 10min, rakenteet 10min, annossuunnittelu noin 1,5h
- Lääkäri 1 h (jos oltaisiin lähdetty miettimään isomman kerta-annoksen sterotaktistyyppistä boosterhoitoa, niin sitten annoksia tms olisi pitänyt miettiä, koska emme SRS yleensä ole käyttäneet metastaasihoidoissa). Annossuunnittelu: 5,5h fyysikko
- 20min
- Piirto 1h, Annossuunnittelu 1h
- Piirto 15min, suunnittelu 15min

Kasvaako nälkä syödessä?

Kiitos kuulijoille
ja
SUURI KIITOS
niille, jotka tekivät
suuren työn
potilasesimerkin
parissa

Eeva ja Hanna