



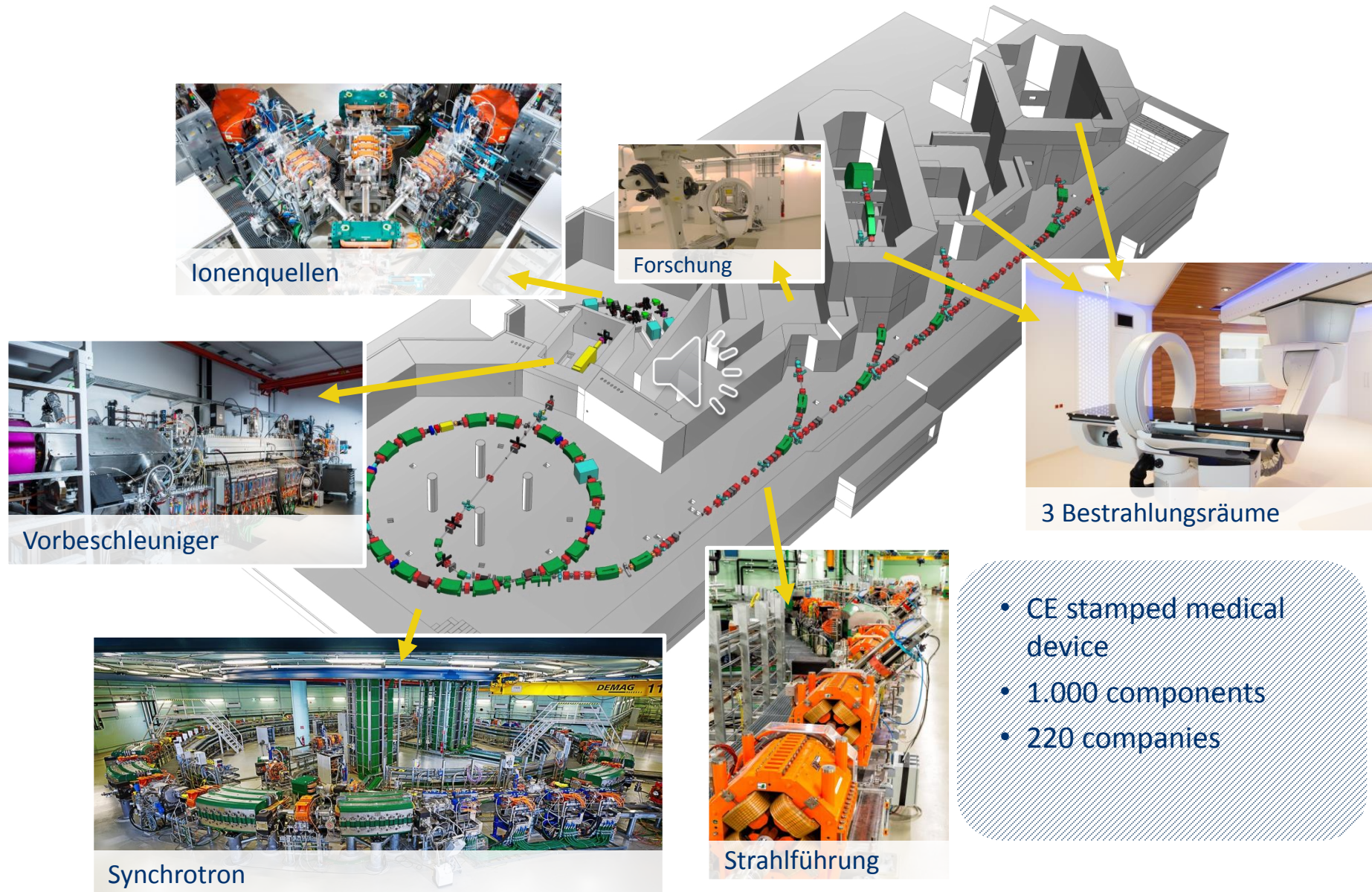
Treatment with Carbon at MedAustron

Dr. Piero Fossati
MedAustron
Scientific Director



No conflict of interest

MedAustron



- CE stamped medical device
- 1.000 components
- 220 companies

Rational use of exclusive carbon ions RT

- When macroscopic disease is present
- When Local control is difficult to achieve with low LET
- When local control can impact survival

Protons vs. Carbon Ions

Protons

- H&N SCC
- Meningioma
- Lymphoma
- Anal cancer
- RMS
- Ewing Sarcoma
- Children

Carbon Ions

- Salivary gland
- Other sarcoma
- Mucosal Melanoma
- Local pelvic recurrence
-



Osteosarcoma of the Trunk

Matsunobu A, Imai R, Kamada T, et al.

Impact of Carbon Ion Radiotherapy for Unresectable Osteosarcoma of the Trunk.

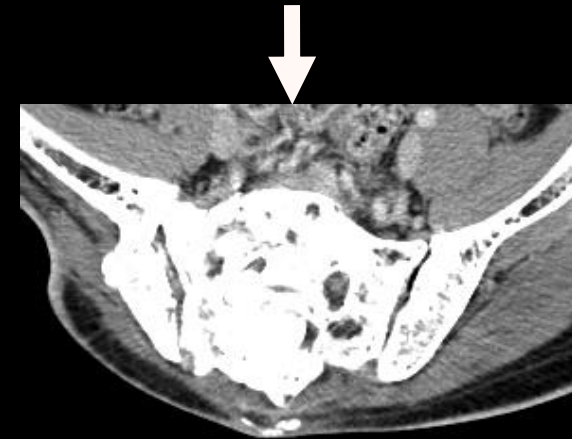
Cancer 2012;118:4555-4563.



At 13 years



At 9 years



At 7 years

Chondrosarcoma

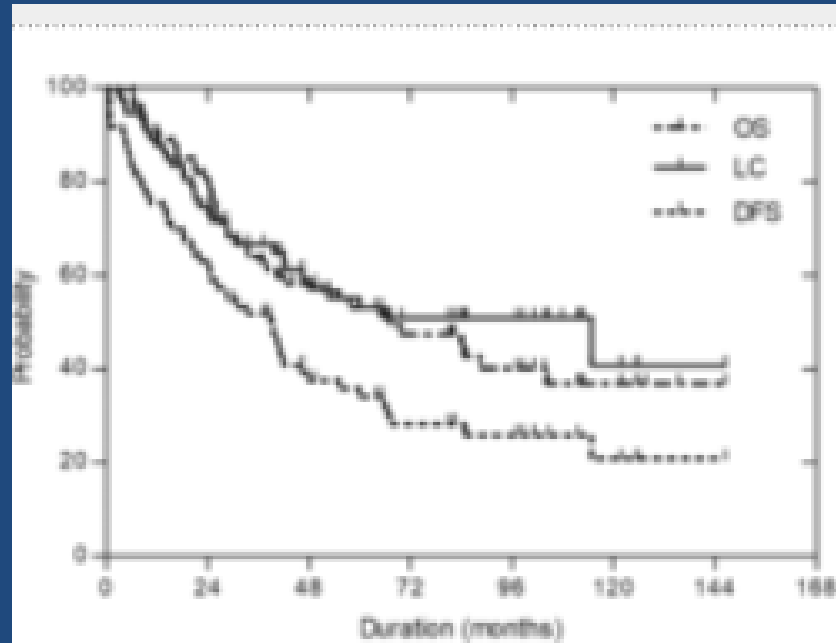
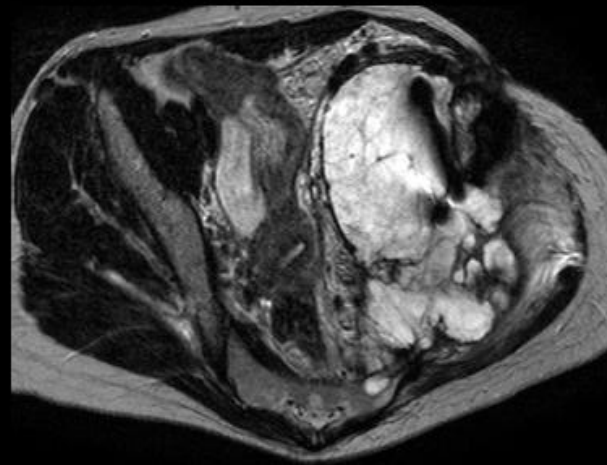


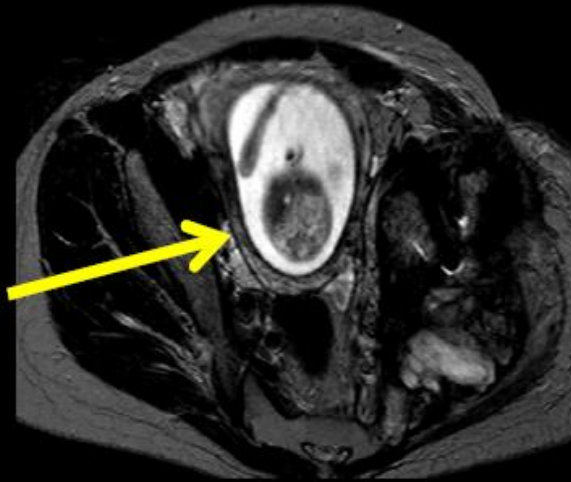
Figure 2.

Local control (LC), overall survival (OS), and disease-free survival (DFS) rates for the whole group of 73 patients with 75 chondrosarcomas. The 5-year rates were 53%, 53%, and 34%, respectively.

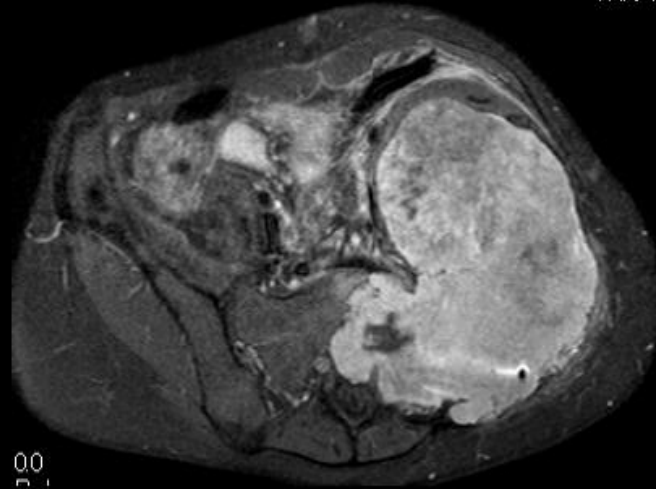
29 year-old female recurrent chondrosarcoma (G2) after surgery



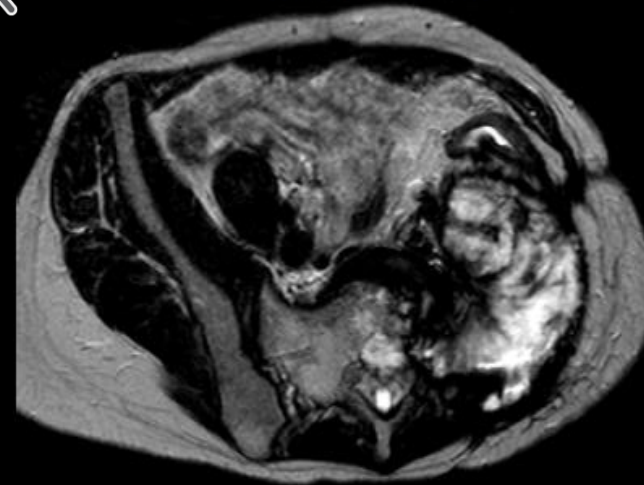
Before CIRT



16 months after CIRT



Before CIRT



5 years after CIRT

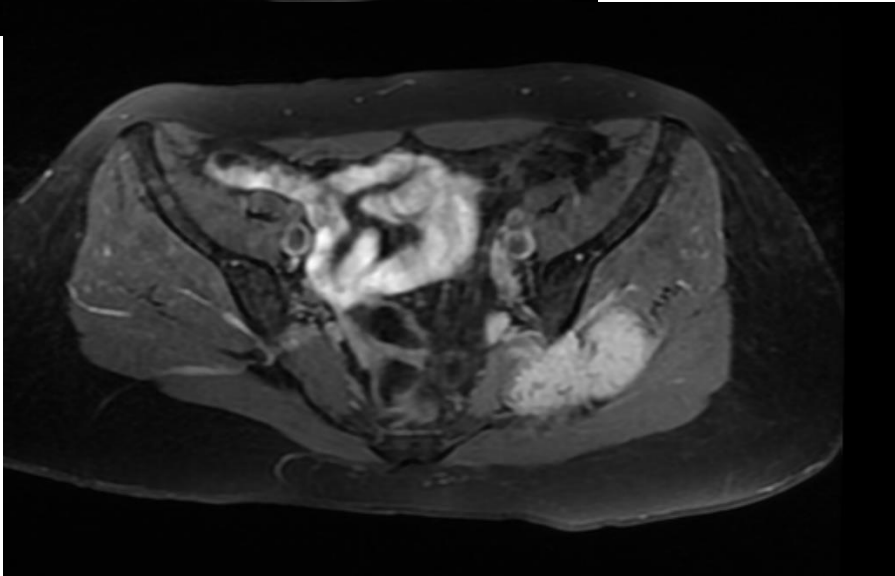
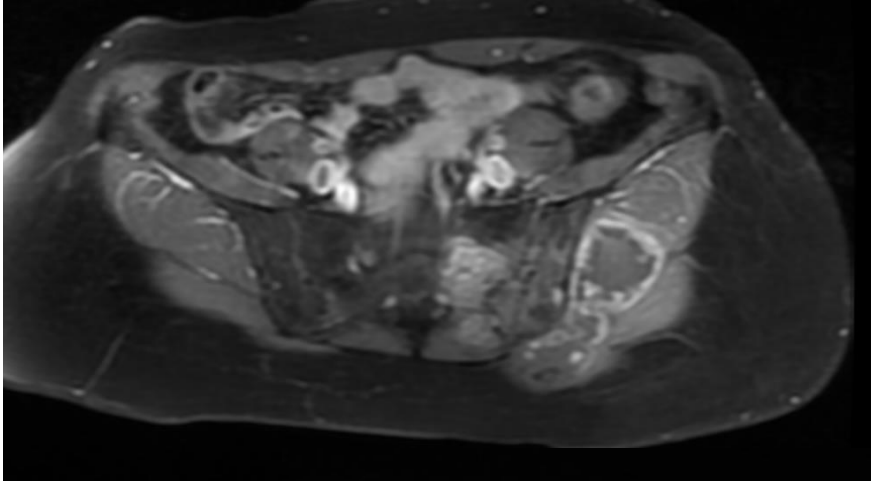
In Oct 2014 she is pregnant again.

Ovary

uterus



Female 50 yo, chondrosarcoma G1,
The lesion was judged technically resectable but
with a mutilating procedure



We gave indication to Carbon Ion Radiotherapy

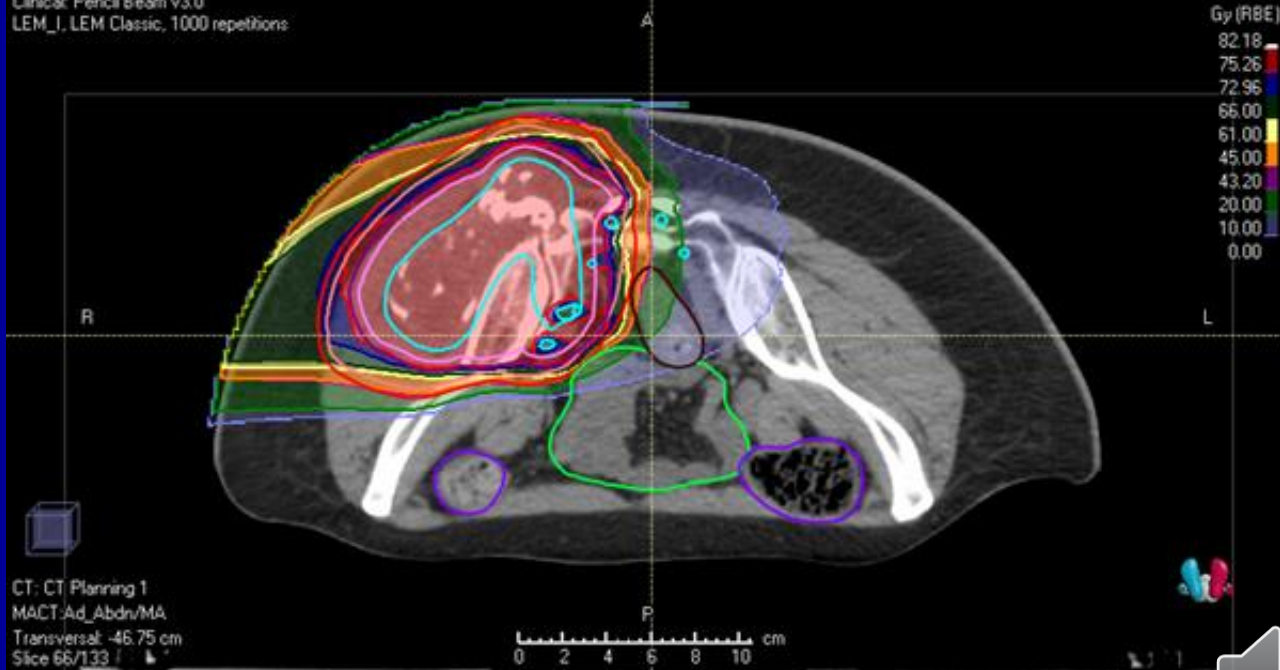
- 76.8 Gy RBE in 16 fractions of 4.8 Gy RBE at 4 fractions per week
- CTV1 → 9 fractions up to 43.2 Gy RBE

macroscopic tumor + left hemi-sacrum + left sacroiliac joint, + infiltrated left gluteal muscle, + left infiltrated iliac neurovascular bundle + iliac bone at risk of infiltration + paravertebral muscle up to L3 + biopsy tract

- CTV2 boost with additional 7 fractions

macroscopic tumor + areas at high risk for microscopic infiltration into the left hemi-sacrum + left sacroiliac joint, + infiltrated left gluteal muscle, + left infiltrated iliac neurovascular bundle + iliac bone at high risk of infiltration + paravertebral muscle up to L4

Plan dose (RBE): Plan1CT1PTV12clR2 (CT Planning 1)
Clinical: Pencil Beam v3.0
LEM_I, LEM Classic, 1000 repetitions

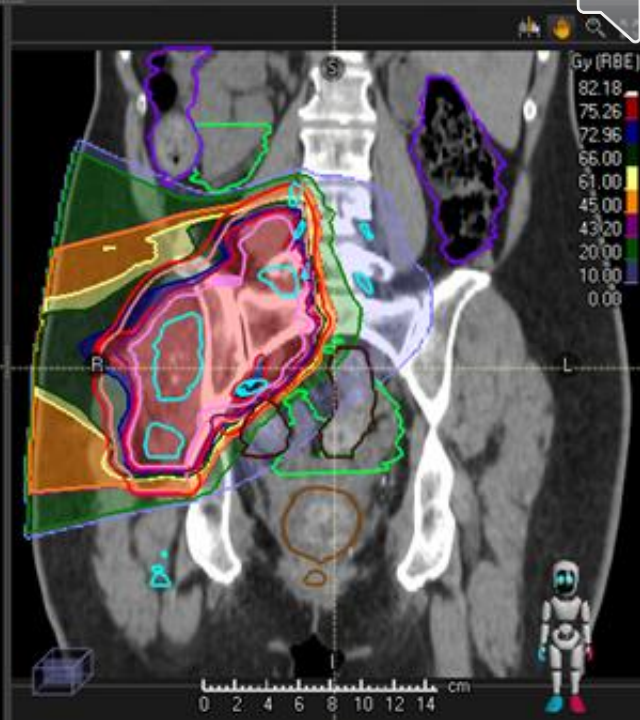
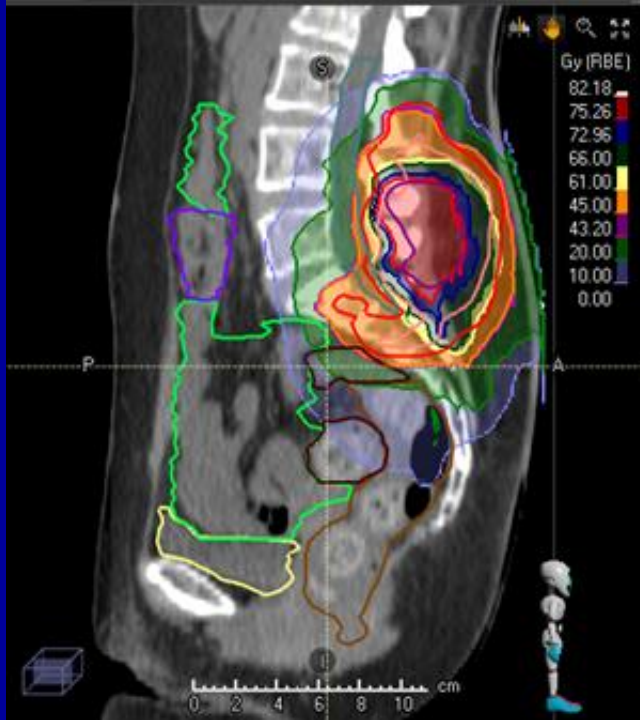


CT: CT Planning 1
M&CT:Ad_Abdr/MA
Transversal: -46.75 cm
Slice 66/133

Current
Select dose for current beam set Plan dose (RBE): Plan2CT2PTV12clR2 (CT Planning 2)



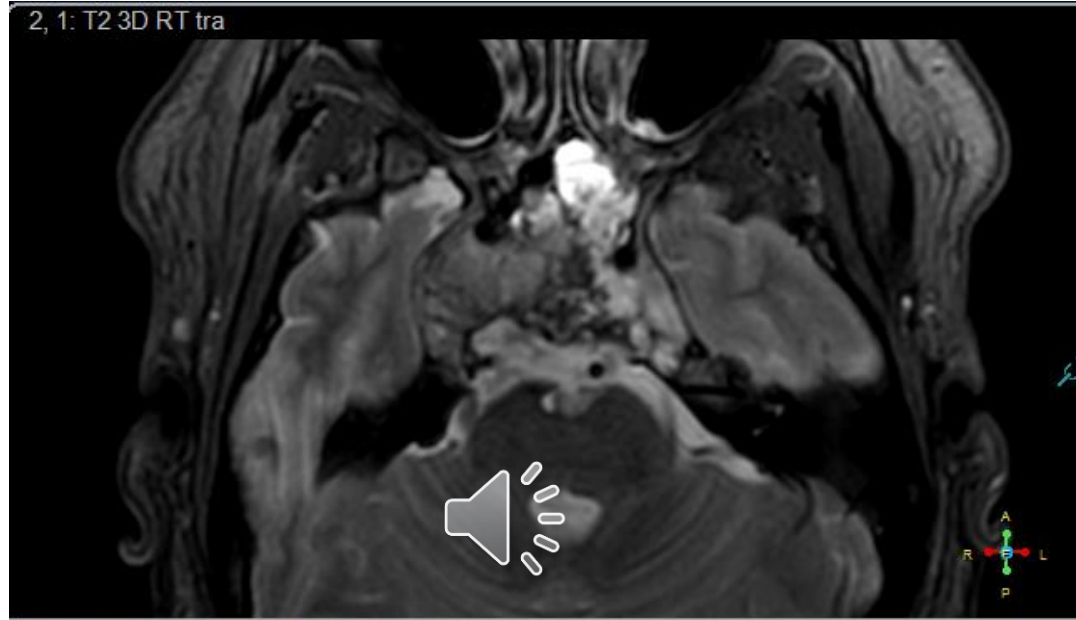
CT: CT Planning 2
M&CT:Ad_Abdr/MA
Transversal: -42.60 cm
Slice 49/104



Skin tox G1 after 4 weeks (no other side effect)

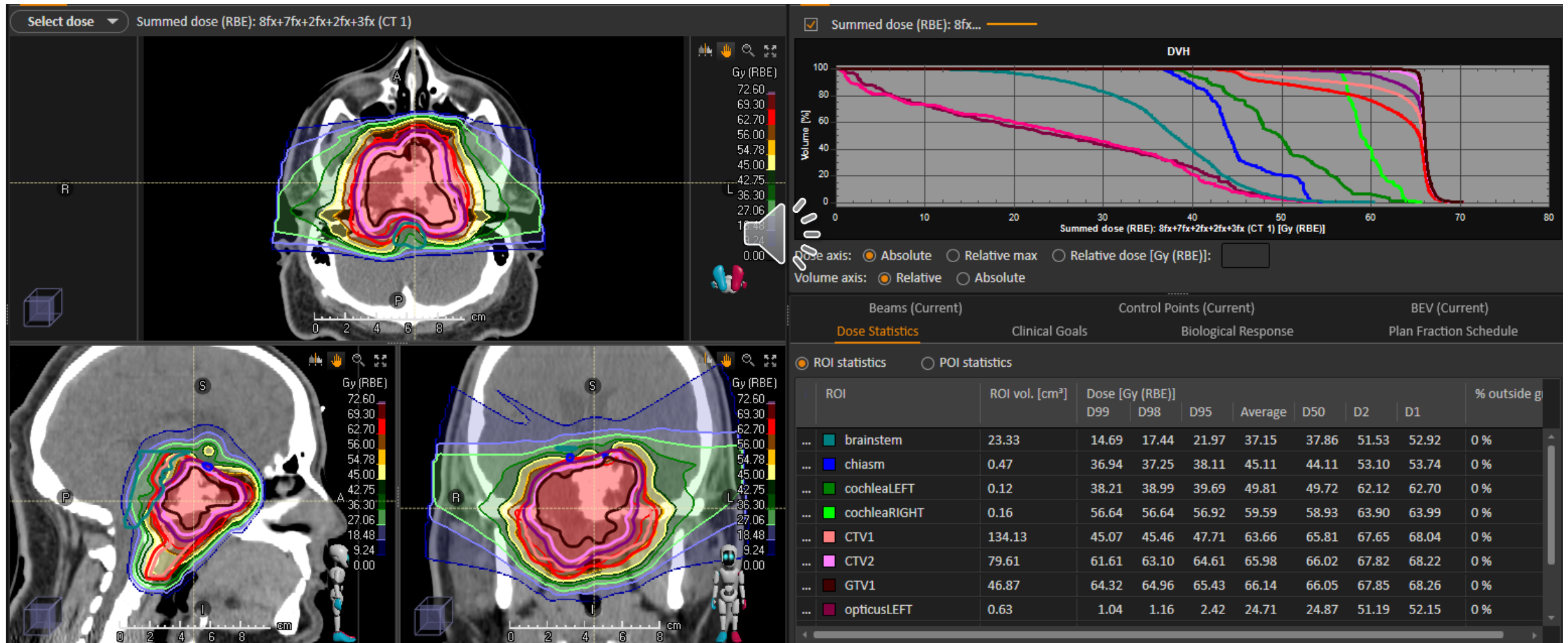


Female 27 yo, Large clivus chordoma after surgical debulking,



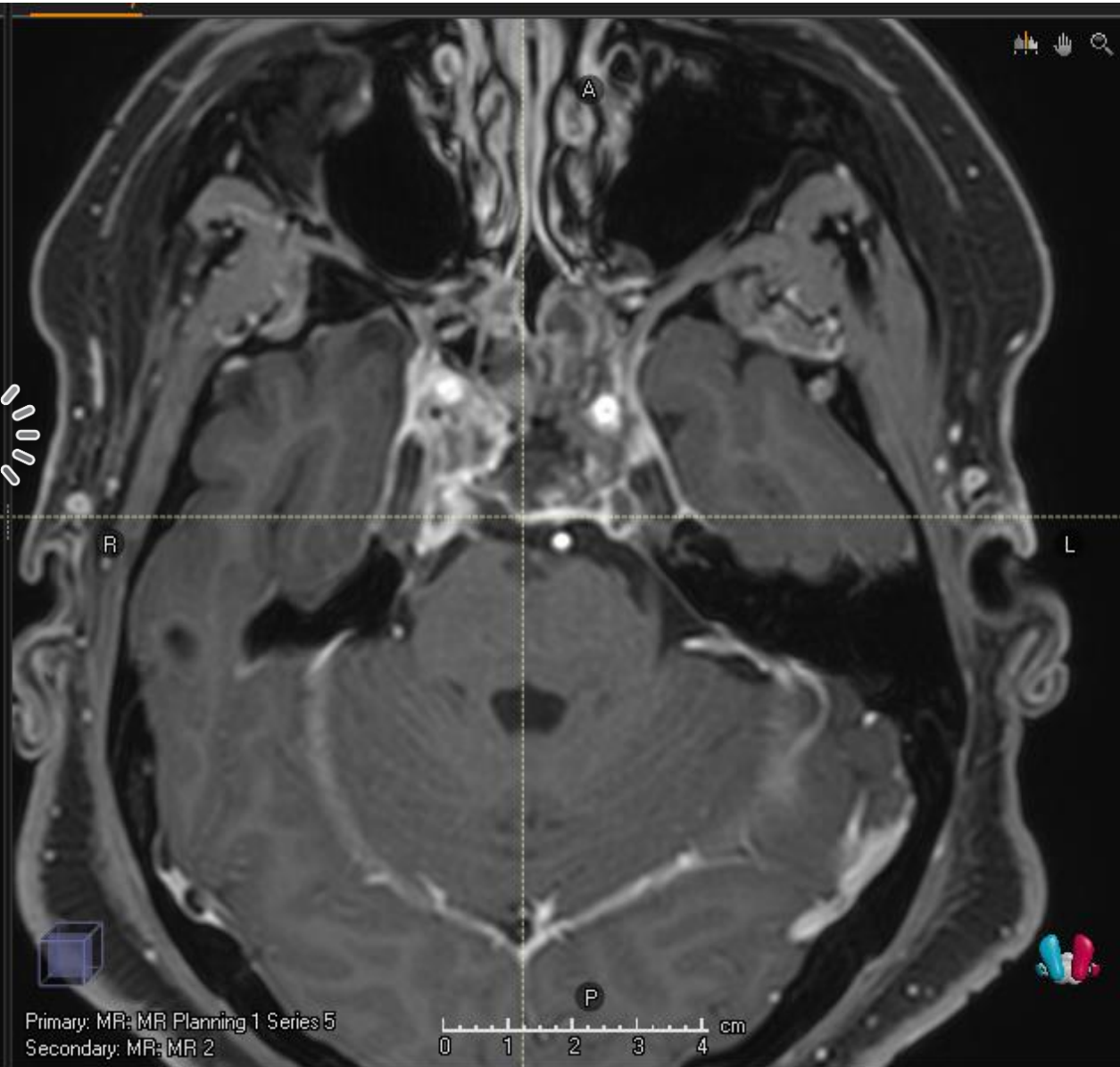
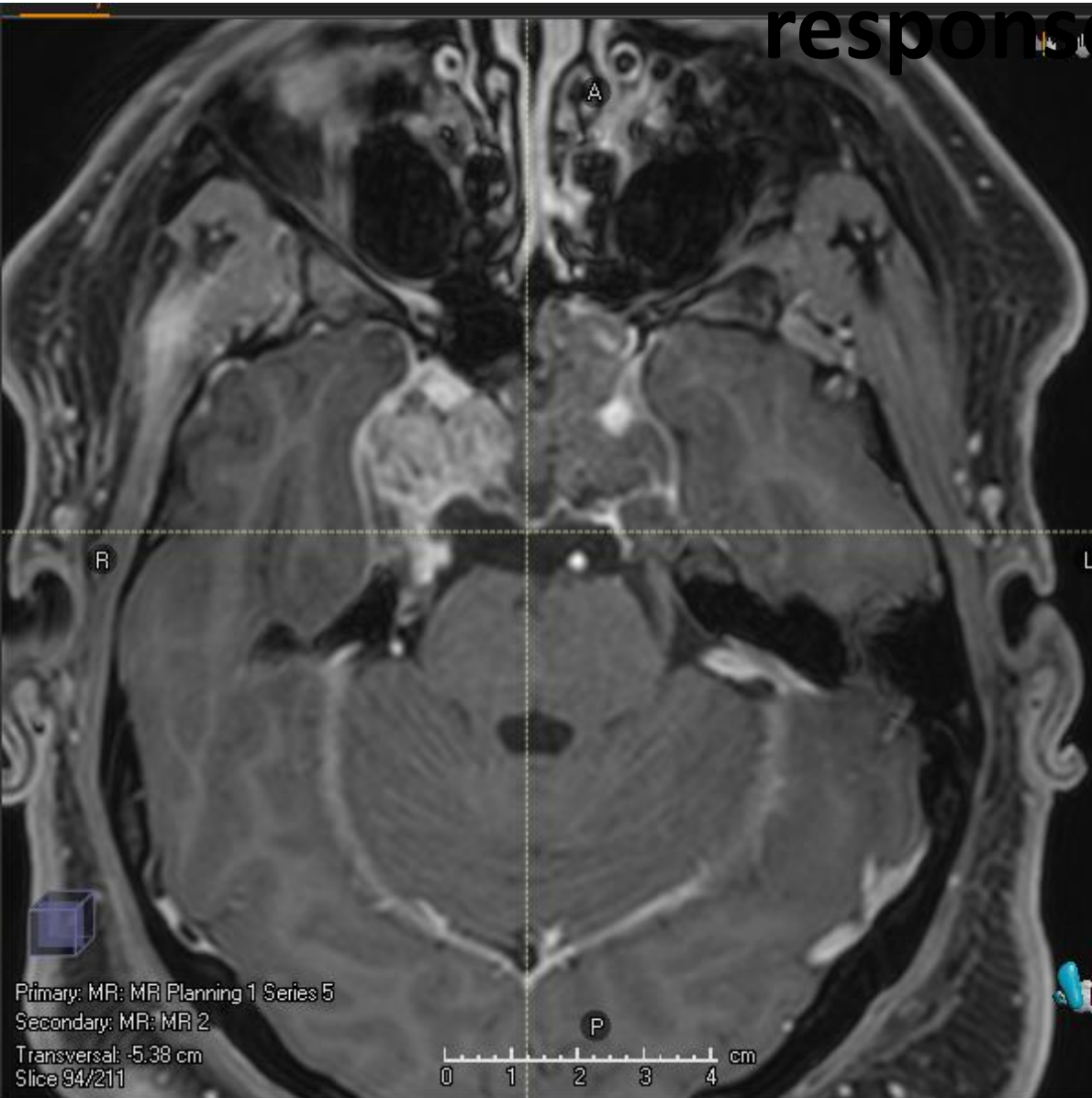
66 Gy RBE in 22 fr of 3 Gy RBE at 5 fr per week

End of RT: alopecia G1

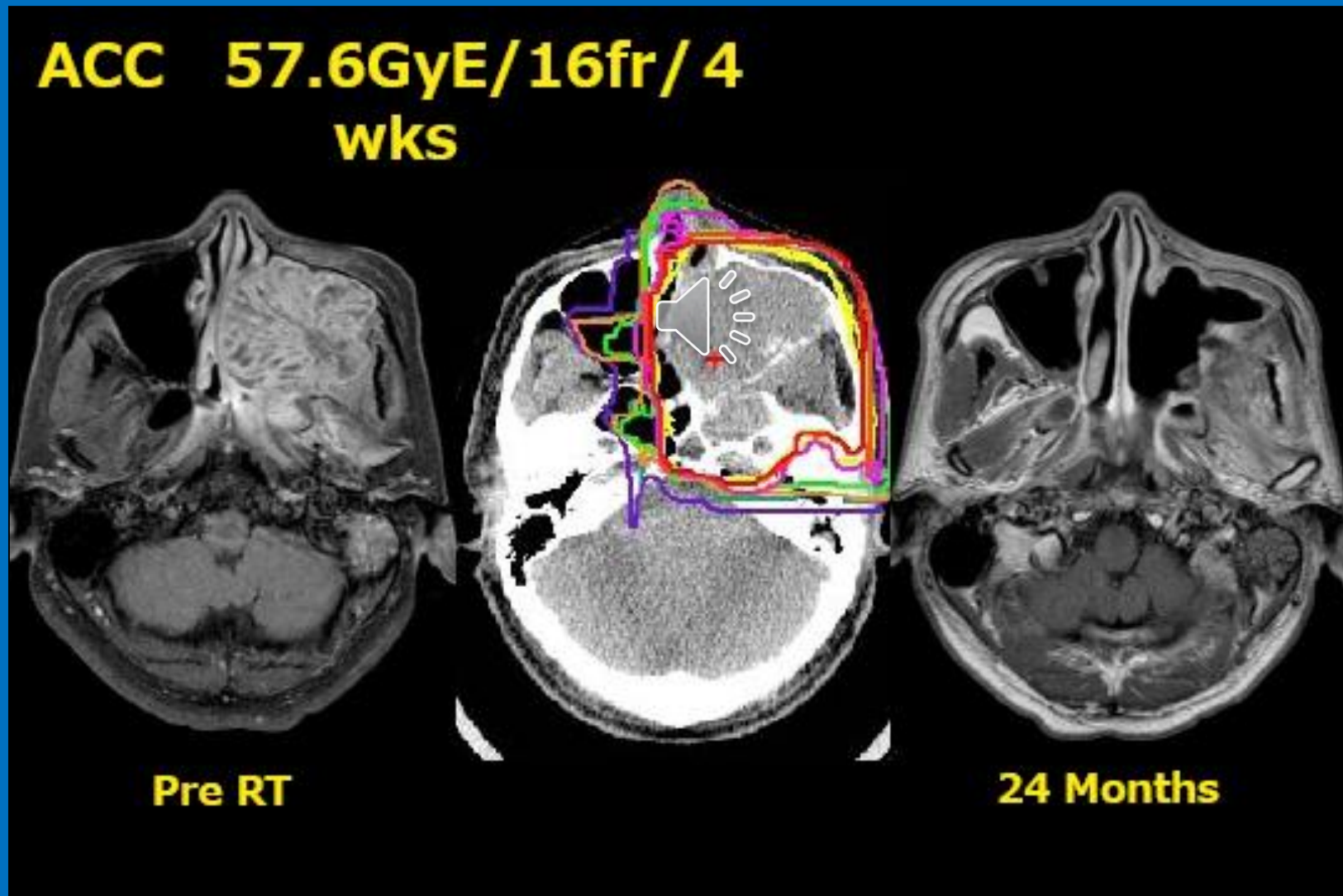


6 months FU major response

response



Salivary gland cancer

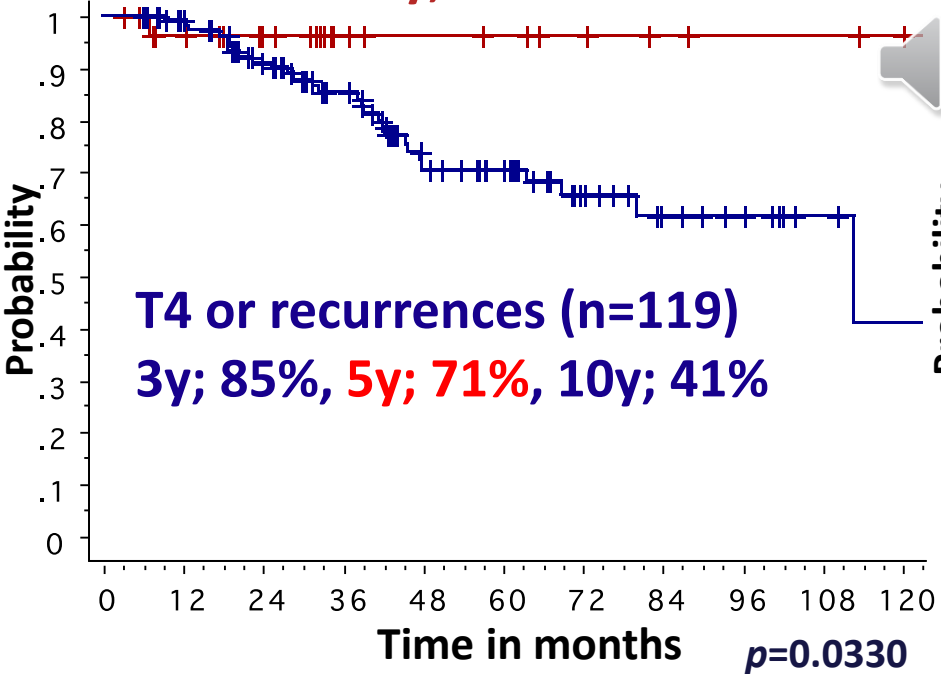


Carbon Ion Radiotherapy for Adenoid Cystic Carcinomas

Carbon ion dose: 64 or 57.6 GyE/16 frs.

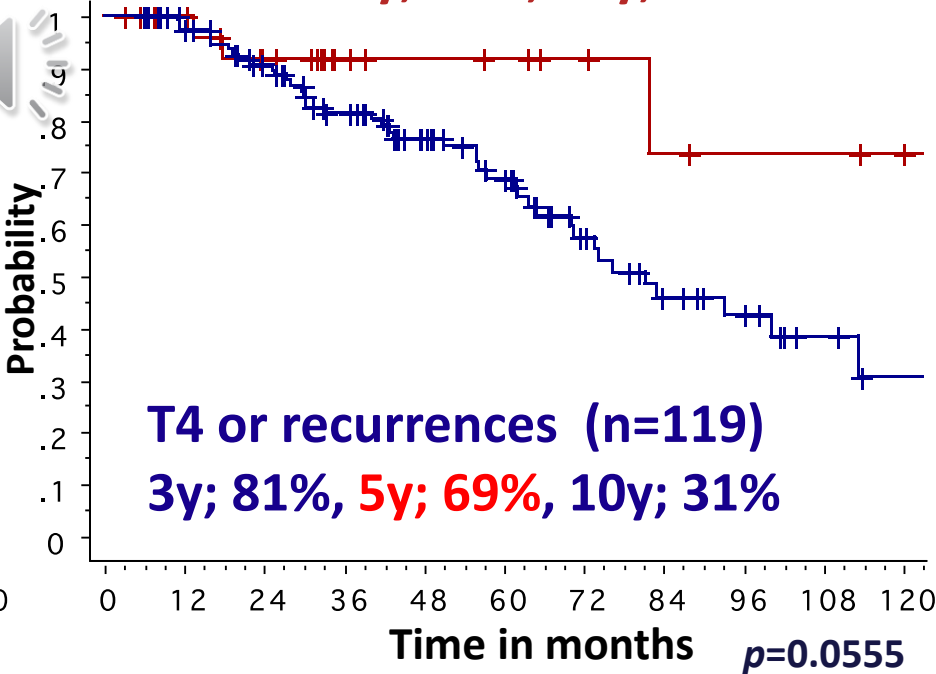
Local Control

T1 to T3 (n=32)
3-10y; 96%



Overall Survival

T1 to T3 (n=32)
3-5y; 92%, 10y; 74%



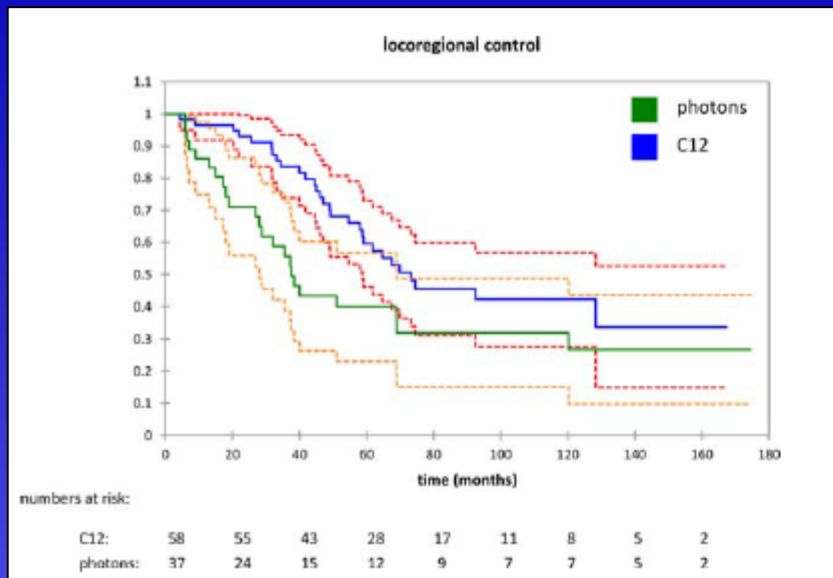


Figure 1. Locoregional control is illustrated in patients with adenoid cystic carcinoma who received C12+IMRT (the C12 group) versus those who received IMRT/FSRT only (the photon group). The locoregional control rate in the C12 group versus the photon group was 83.7% versus 55.6%, respectively, at 3 years; 59.6% versus 39.9%, respectively, at 5 years; and 42.2% versus 32%, respectively, at 10 years ($P = .033$). The dashed lines correspond to the 95% confidence interval.

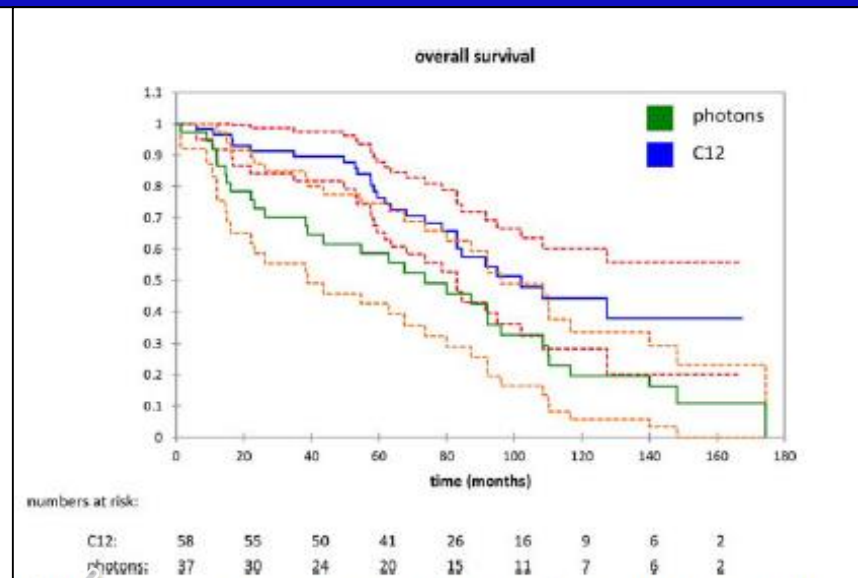
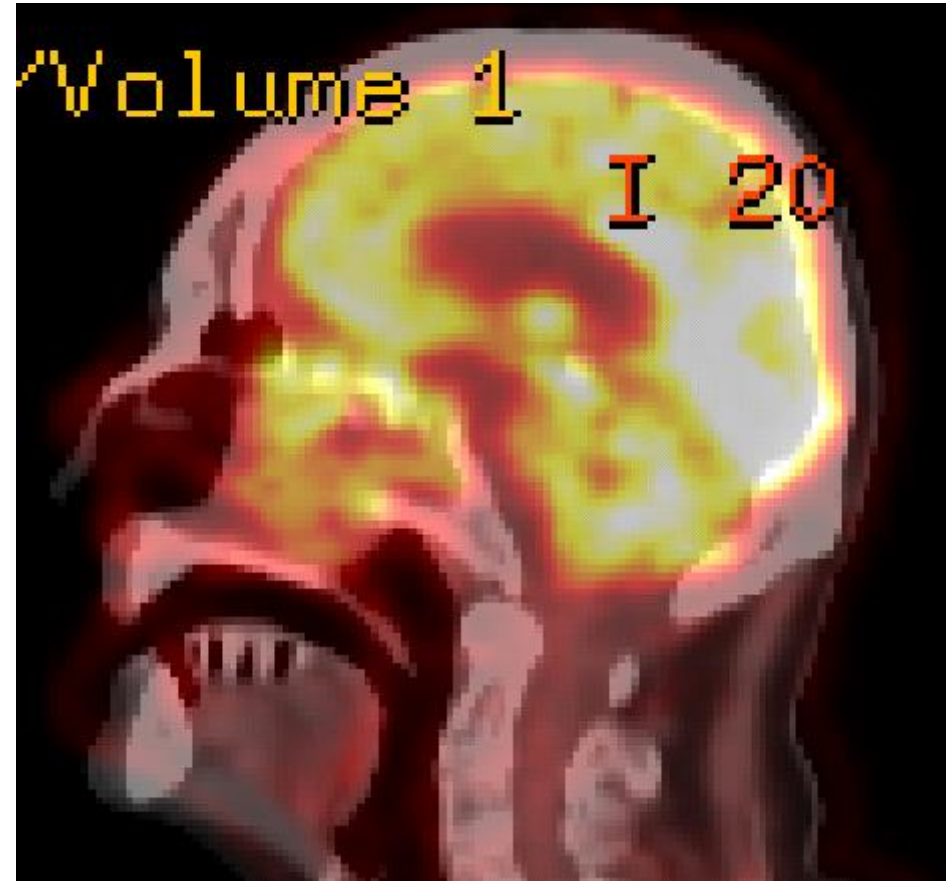
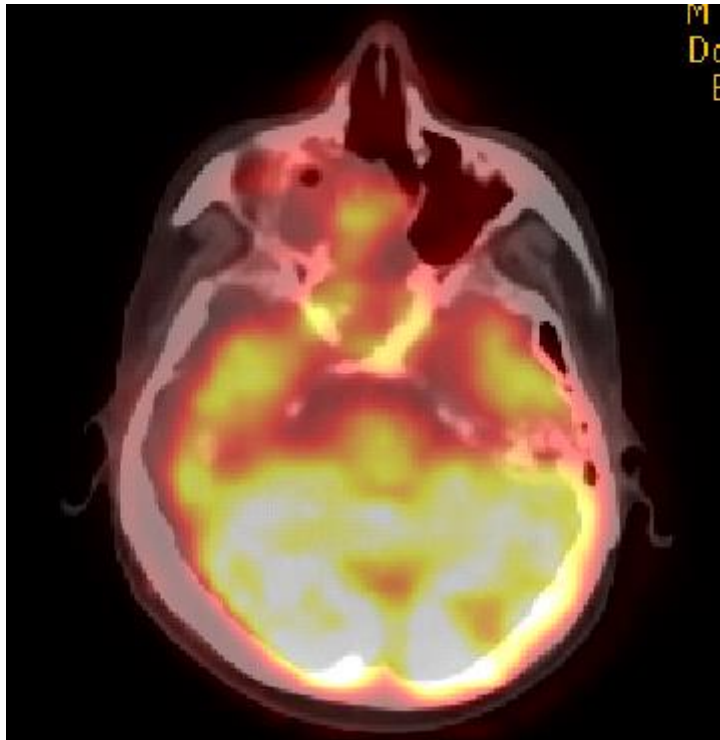


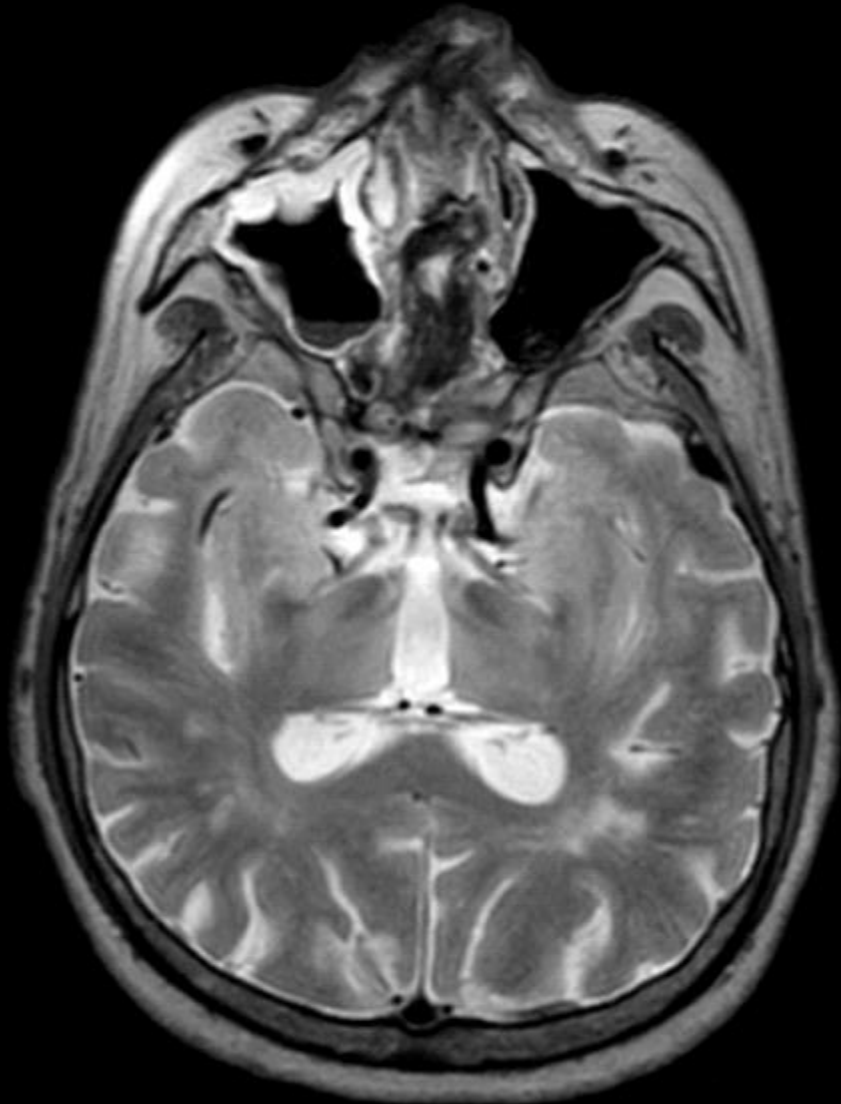
Figure 3. Overall survival is illustrated in patients with adenoid cystic carcinoma who received C12+IMRT (the C12 group) versus those who received IMRT/FSRT only (the photon group). The overall survival rate in the C12 group versus the photon group was 89.6% versus 70.2%, respectively, at 3 years; 76.5% versus 58.7%, respectively, at 5 years; and 44.2% versus 19.6%, respectively, at 10 years ($P = .015$). The dashed lines correspond to the 95% confidence intervals.

(Jensen et al., Cancer, 2015)

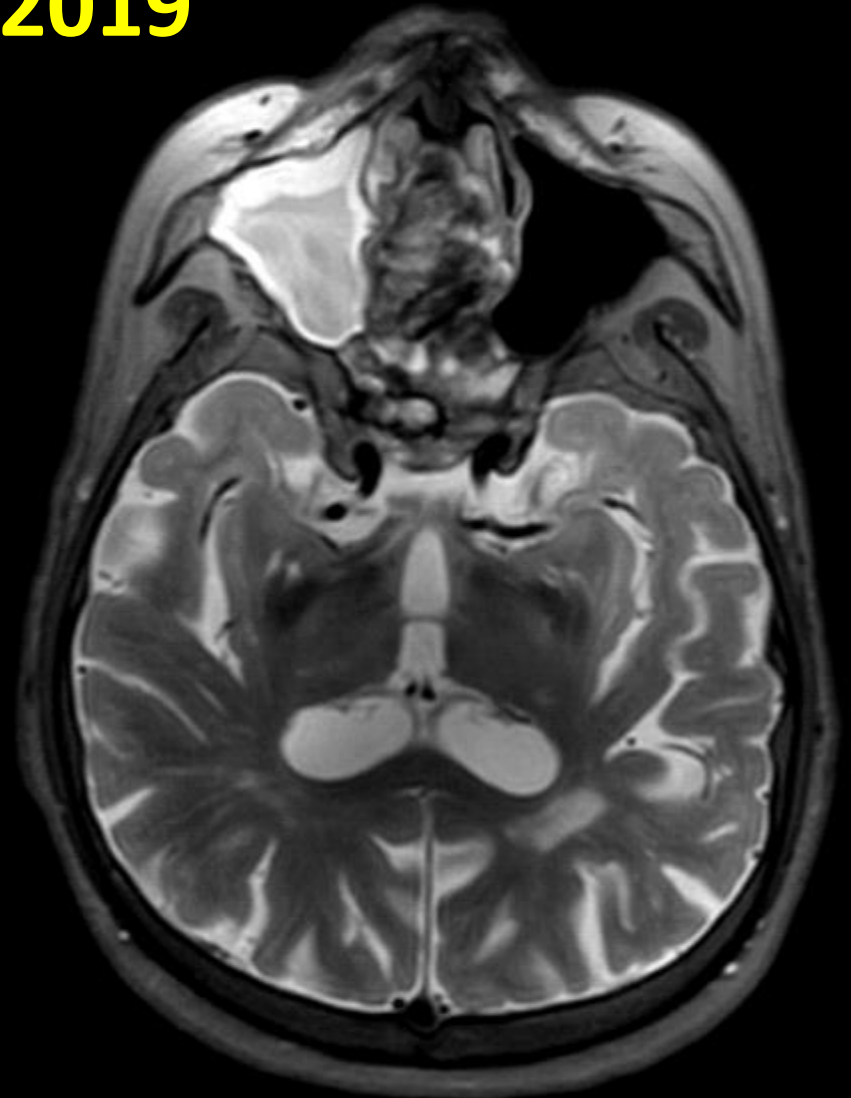
Male 72 yo, Clivus Myxofibrosarcoma after 50.4 Gy 16 years before for pituitary adenoma



Jul 2019



Aug 2019



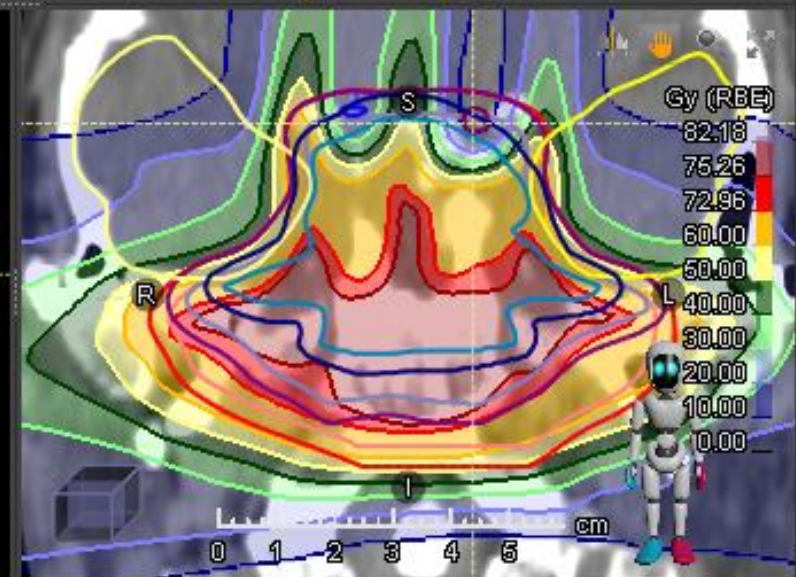
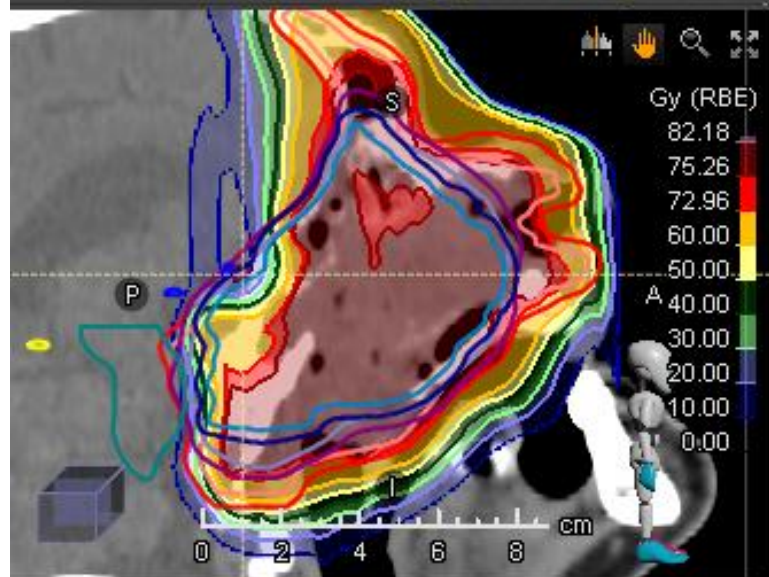
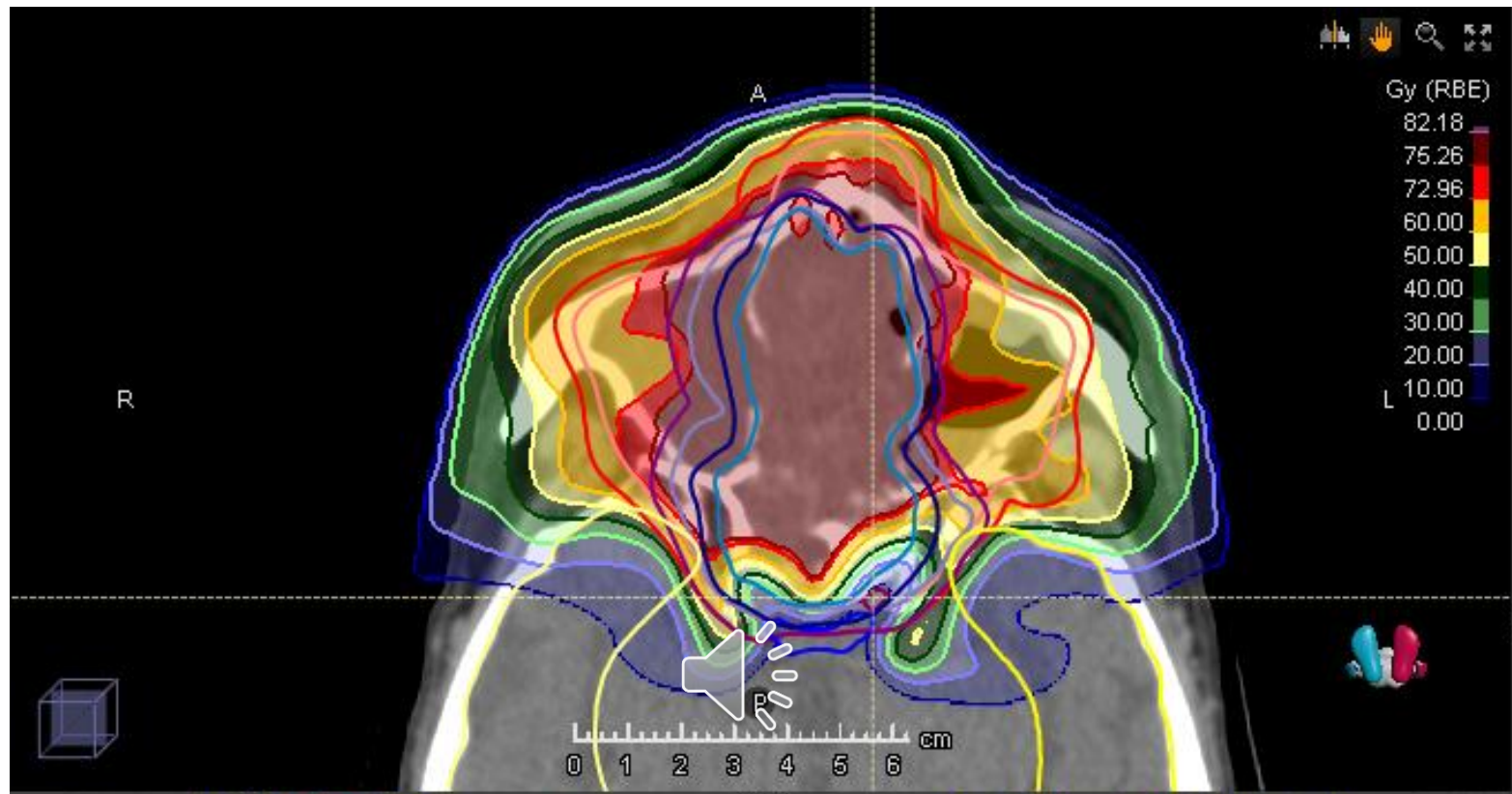
Strategy:

- Chemotherapy was excluded (age and performance status)
- Surgery was deemed not feasible



- We gave indication to
- **High dose carbon ion re-irradiation**

76.8 Gy RBE in 16 fr of 4.8 Gy RBE at 4 fr per week



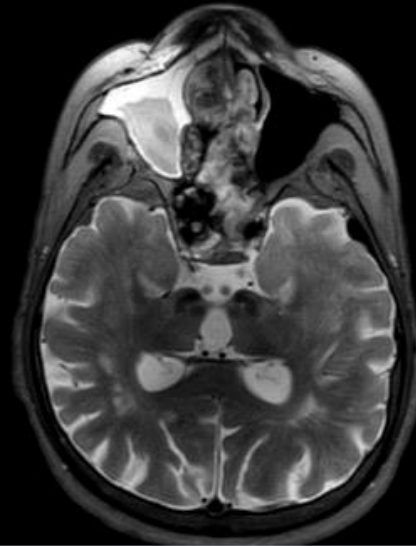
From 78 to 16 Gy RBE in 10 mm (> 6 Gy RBE per mm)



One month FU

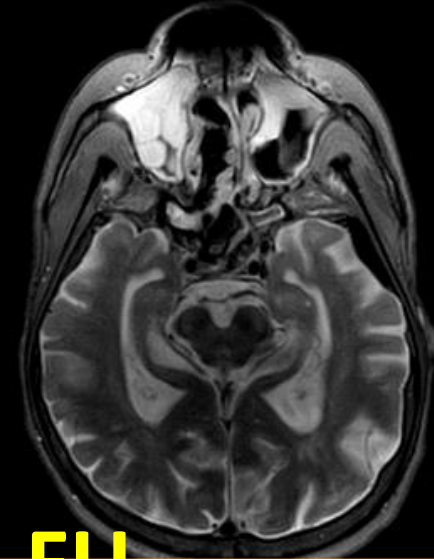
Mucositis G2

2, 1: T2 3D RT tra



Pre

2, 1: T2 3D tra

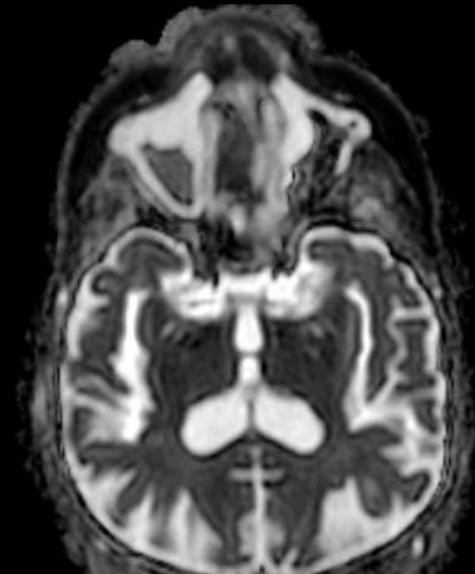


1 month FU

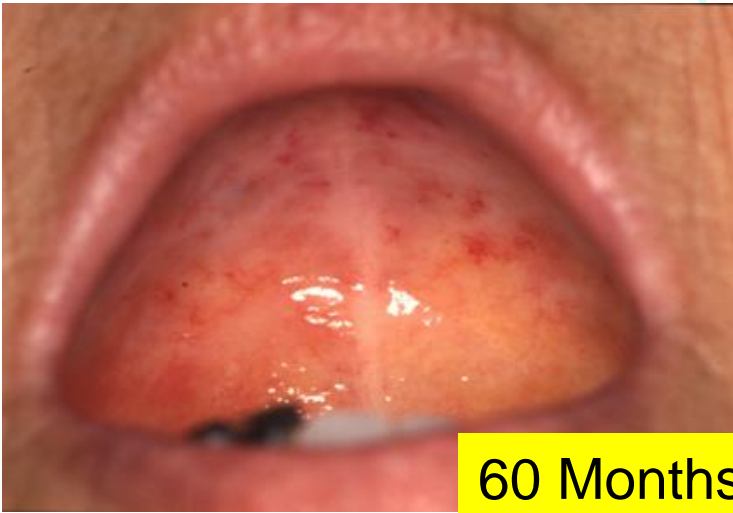
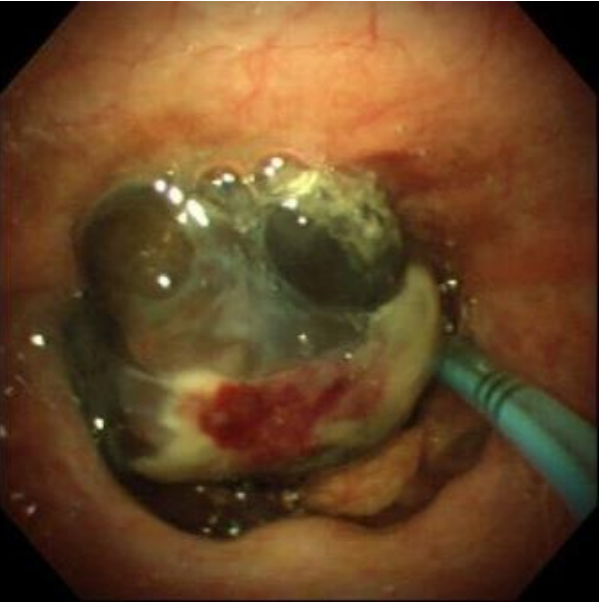
3, 2: dDWI_T2E ADC



4, 2: DWI_T2E ADC



MELANOMA at NIRS



60 Months

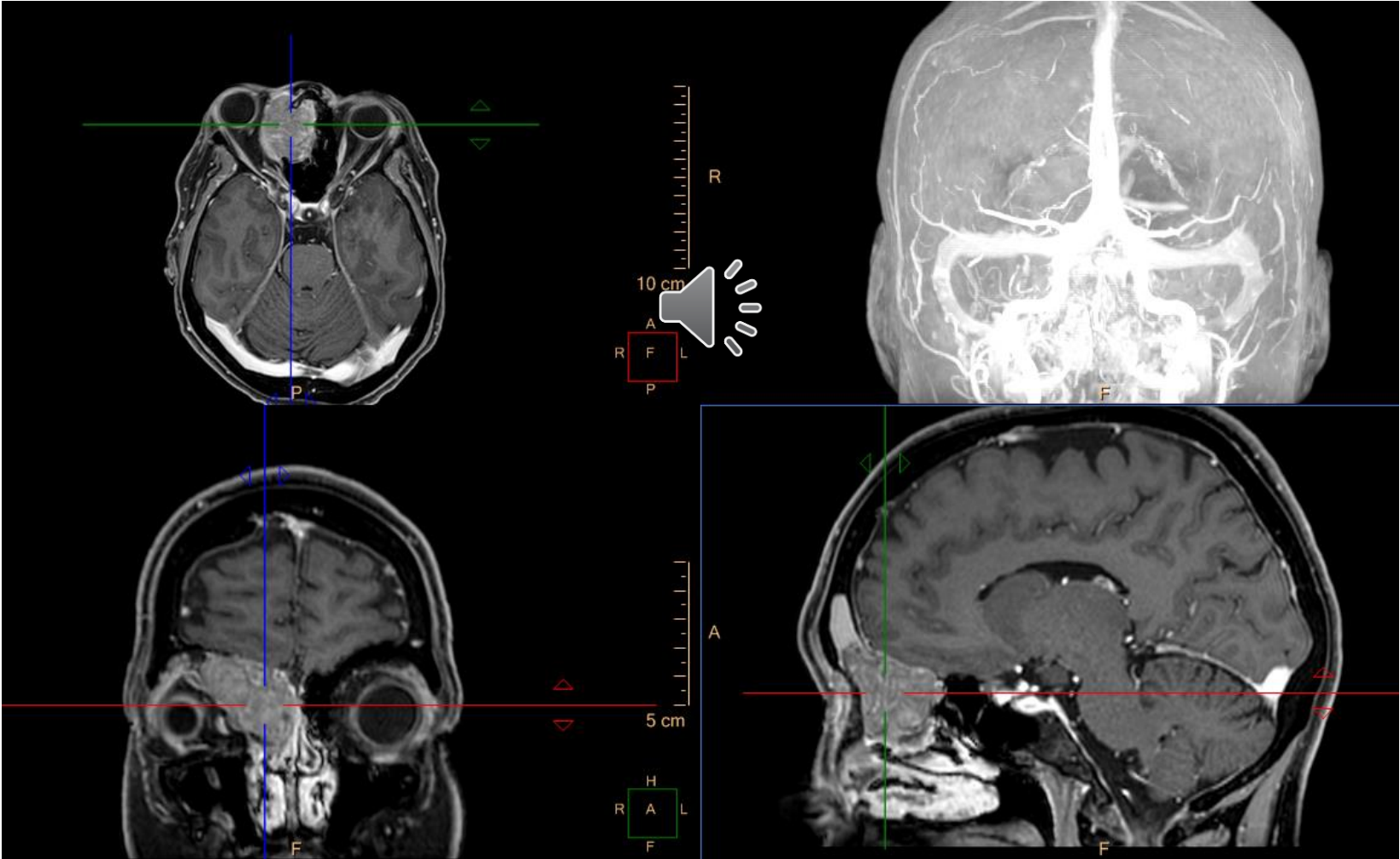


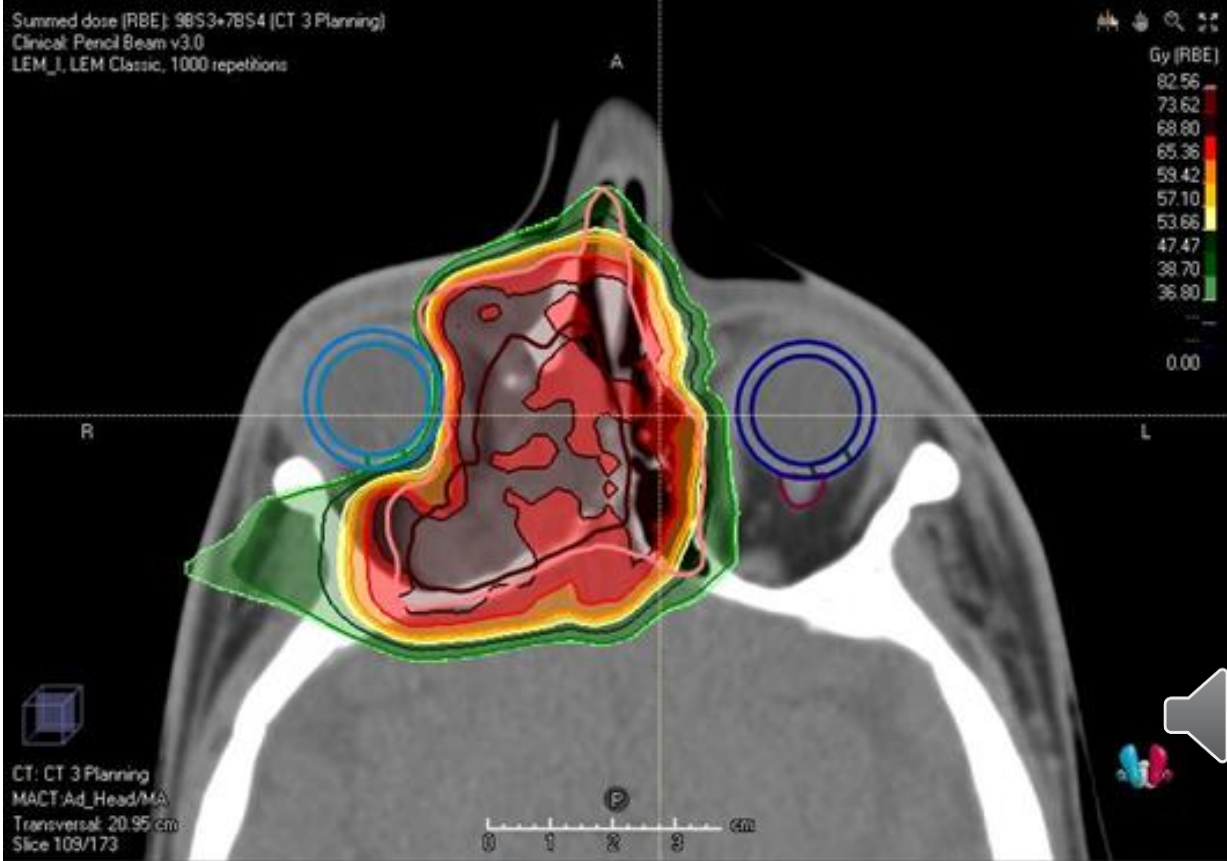
36 Months



100 Months

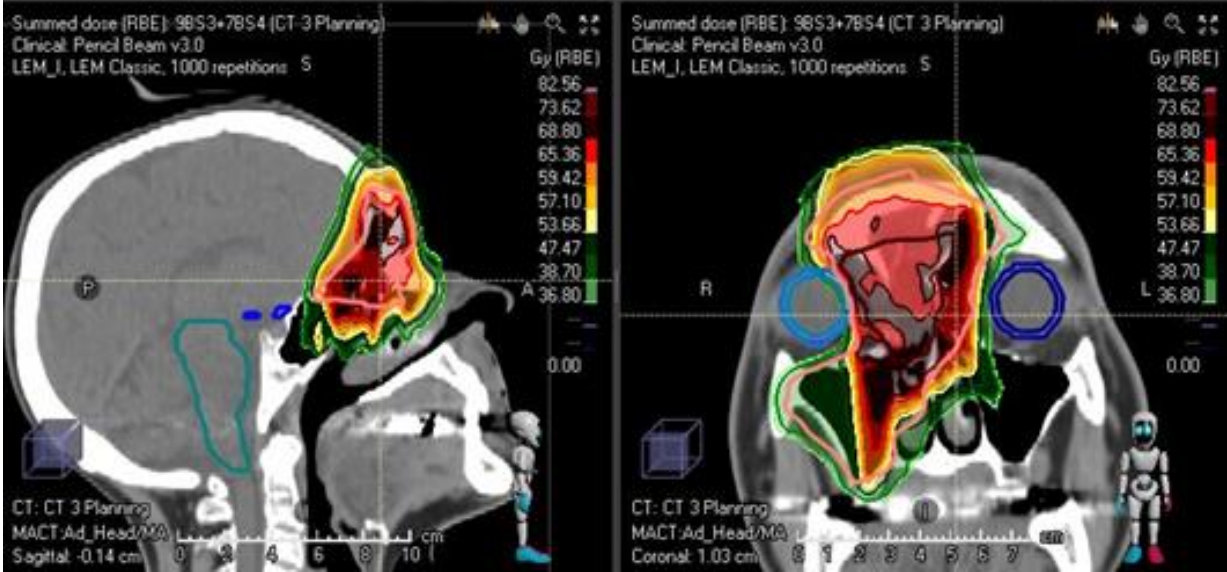
Female 59 yo, mucosal melanoma of the ethmoid sinus



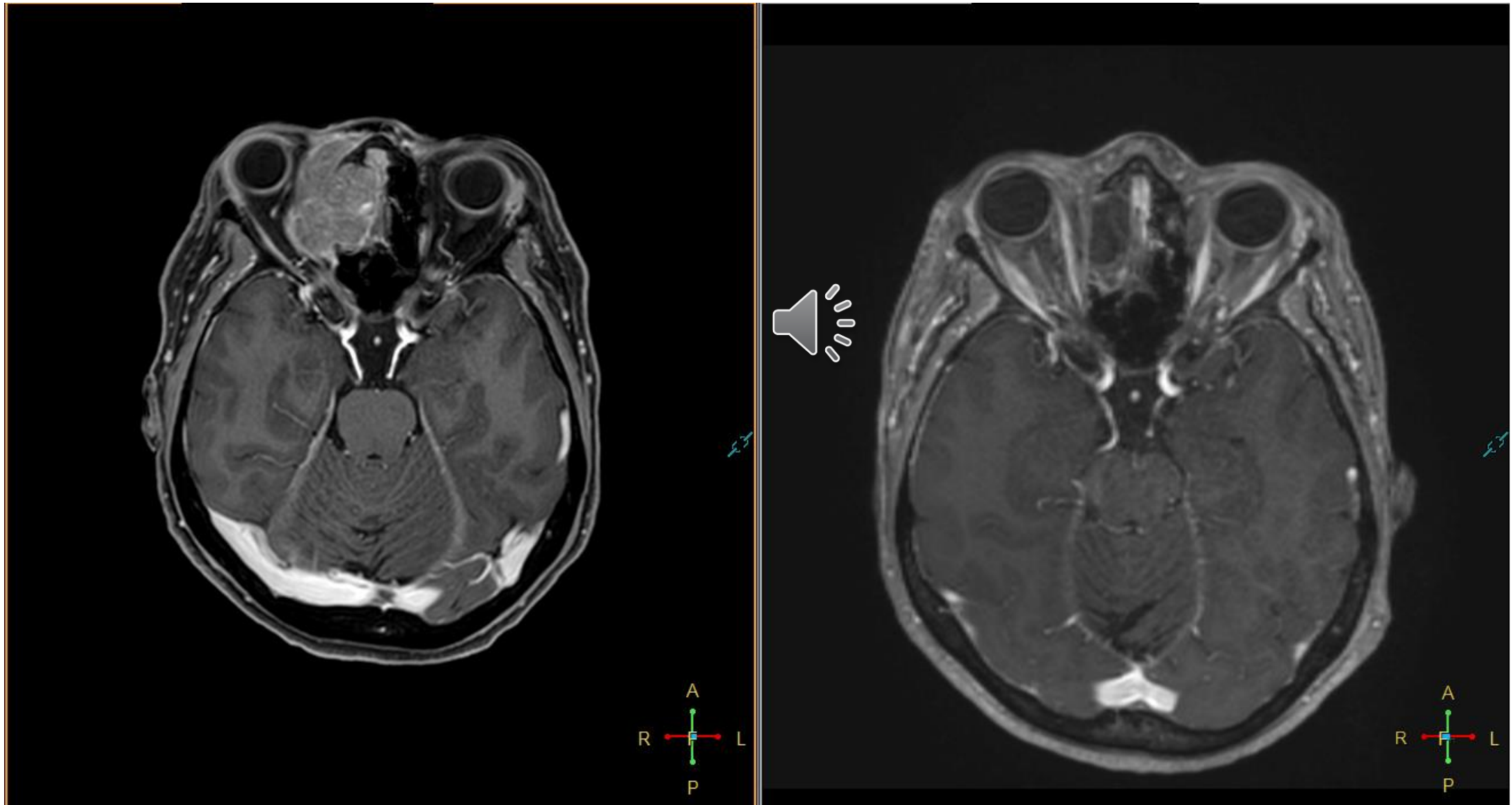


68.8 Gy RBE in 16 fr of 4.3 Gy RBE at 4 fr per week.

The patient was on Pembrolizumab and progressing. End of RT mucositis G2 Skin tox G1



3 months FU CR



Future developments

- LET optimization
- CIRT boost for negatively selected high incidence cancers
- CIRT for pancreas
- CIRT + immunomodulation