Current Status of Carbon Therapy for the Treatment of Cancers

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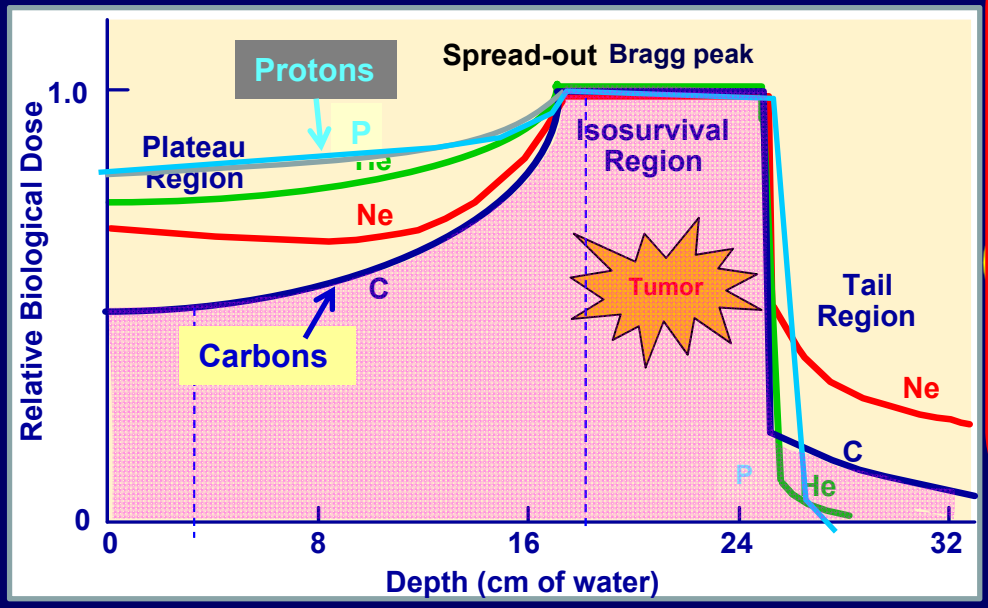
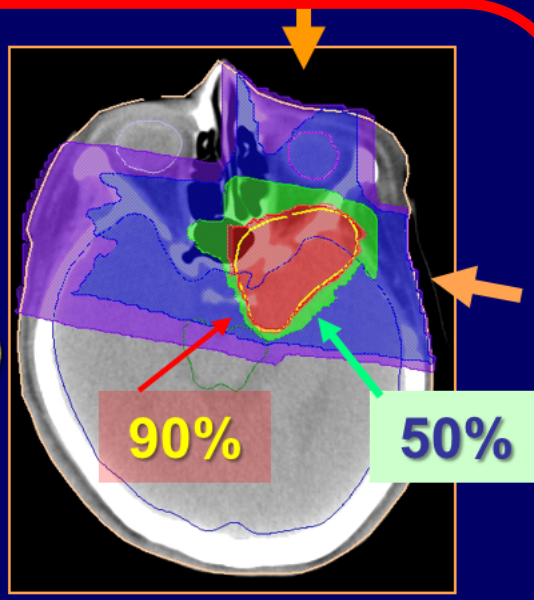
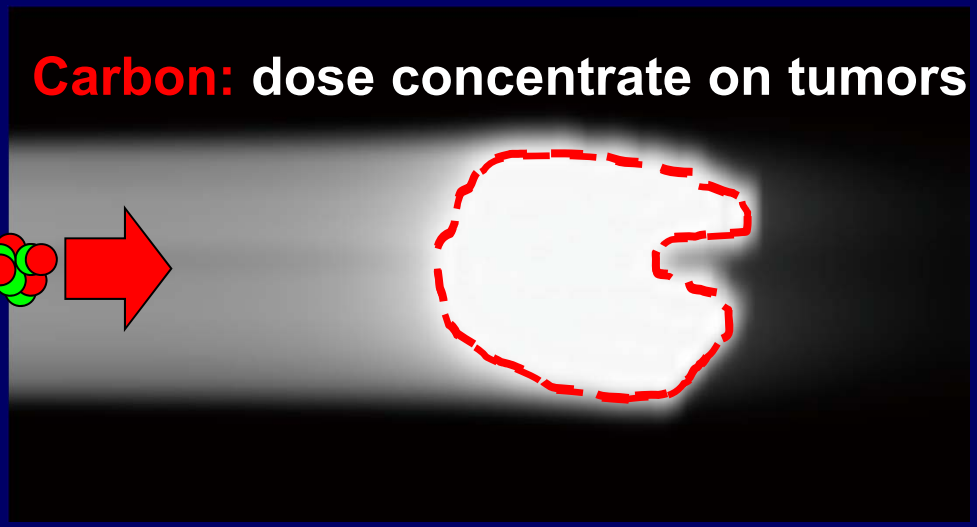
Prevention, Diagnosis, Treatment

Superior dose distribution of Carbons

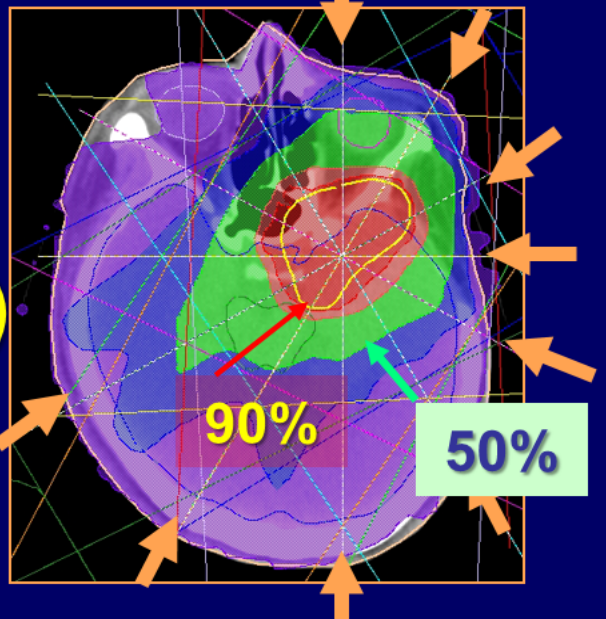


Carbon (3 ports)





IMRT (9 ports)

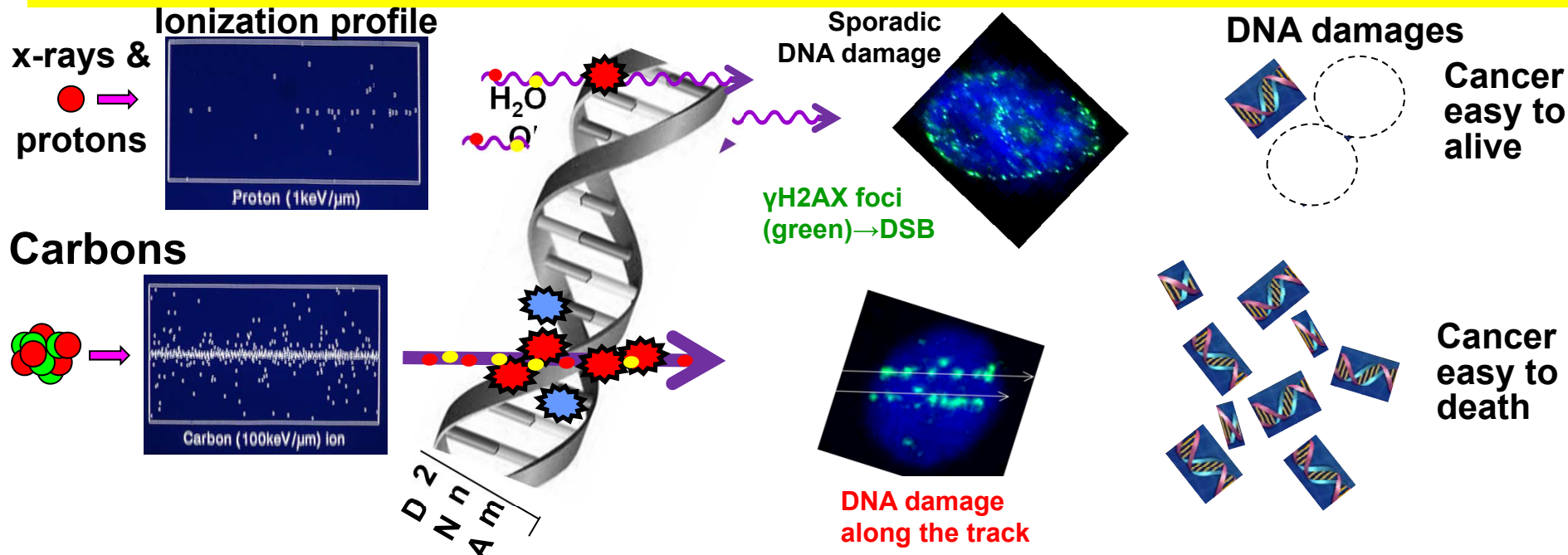


Radiobiology of Carbon Ions

In addition to the superior dose distribution of carbon beams, the beams have superior biological advantage to x-rays/protons.

- **X-rays/protons produce single strand DNA breaks which are easy repaired by the radiation resistant tumor cells.**
- **Carbons generate denser ionizations along trajectory than x-rays/ protons and can produce double strand breaks directly and severer DNA damage and stronger cell killing than x-rays/ protons.**

The strong effects offers greater tumor control benefits for radiation resistant cancers and locally advanced / large cancers than protons.



Short Course Carbon-Ion RT

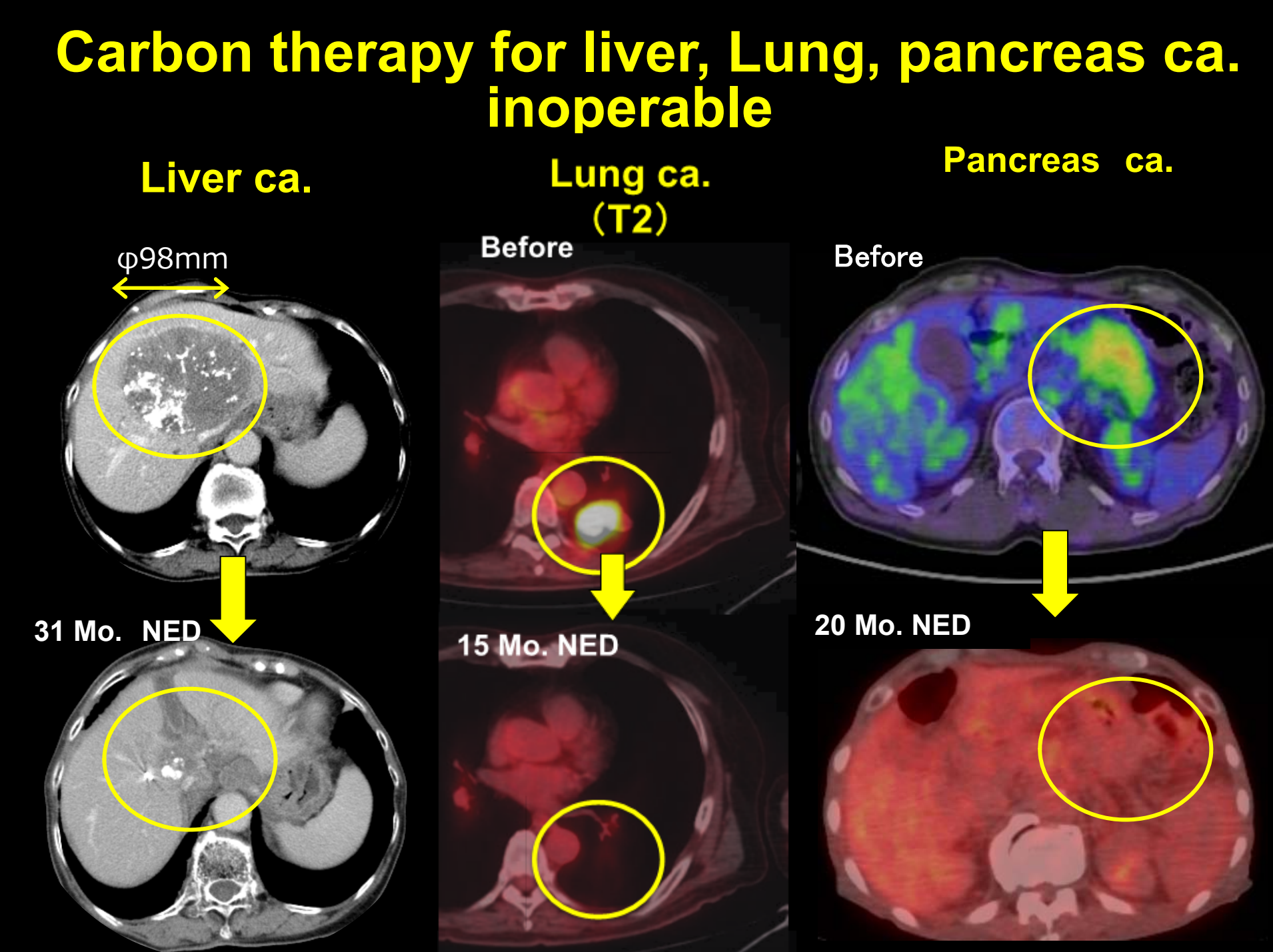
※ In conventional RT, it takes 6-7 weeks with 25-30 sessions.

Cancers	Fractions/	Periods
Head & Neck Ca.	16 frs	/ 4 weeks
Lung Ca. (St. I)	1- 4 frs	/ 1- 4 days
Liver Ca.	4 frs	/ 4 days
Prostate Ca.	12 frs	/ 3 weeks
Sarcoma	16 frs	/ 4 weeks
Rectum Ca.	16 frs	/ 4 weeks

•With this short course of treatment, patient's load and interruption of daily life can be minimized.

•, Many patients can be treated (600 ~1000 pts. / year)

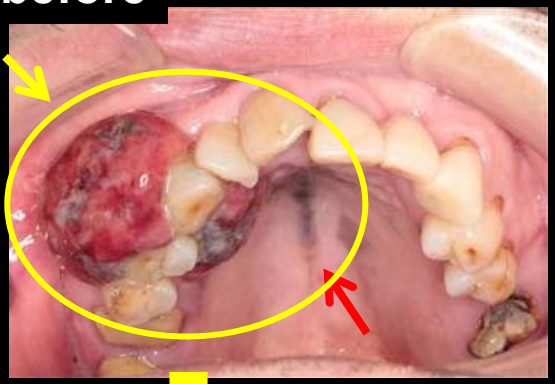
Carbon therapy for liver, Lung, pancreas ca. inoperable



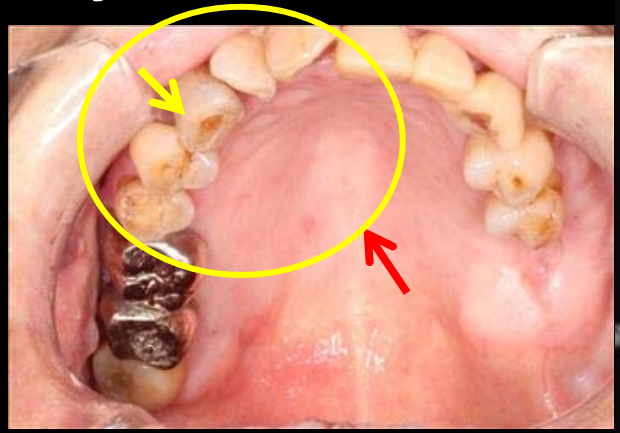
Carbon therapy for radiation resistant tumors inoperable

Gingiva
Malig. Melanoma

before

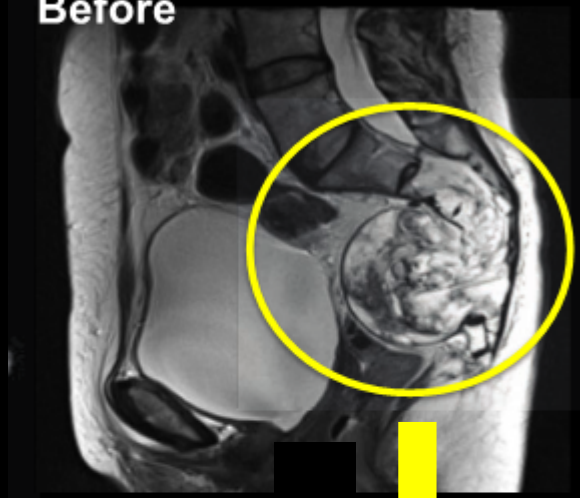


2y6m NED

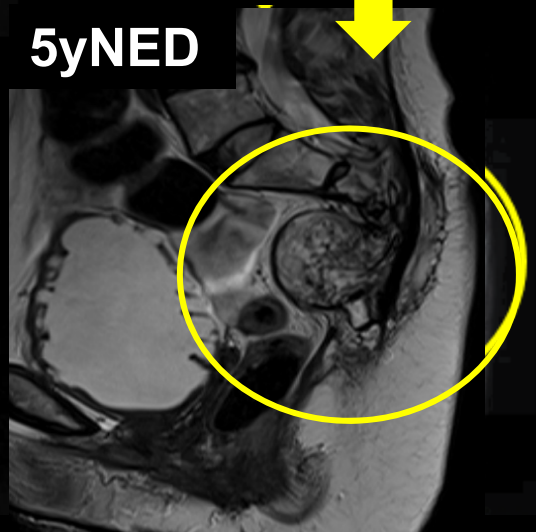


Sacral chordoma

Before

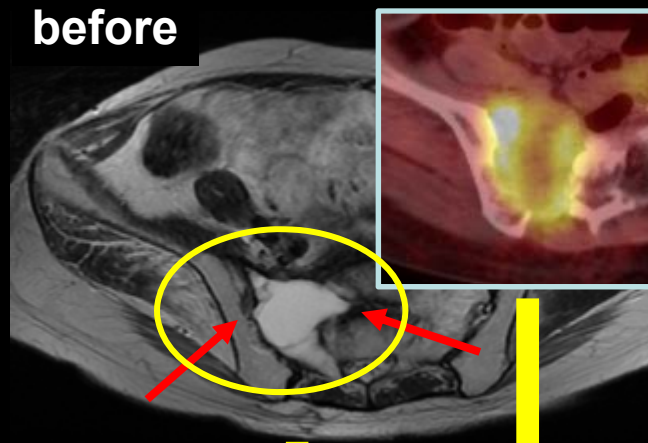


5yNED

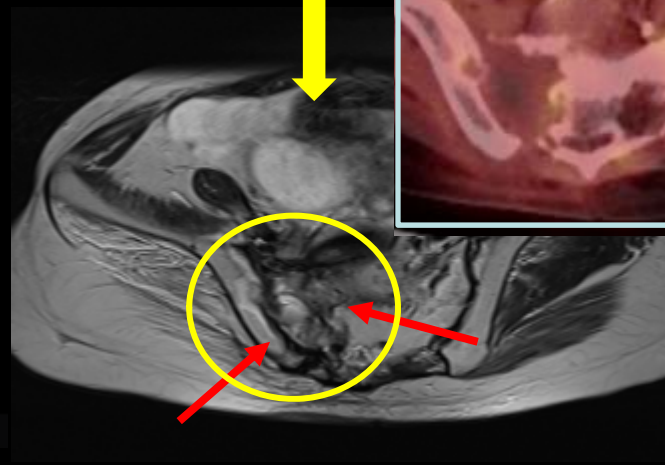


Sacral Osteosarcoma

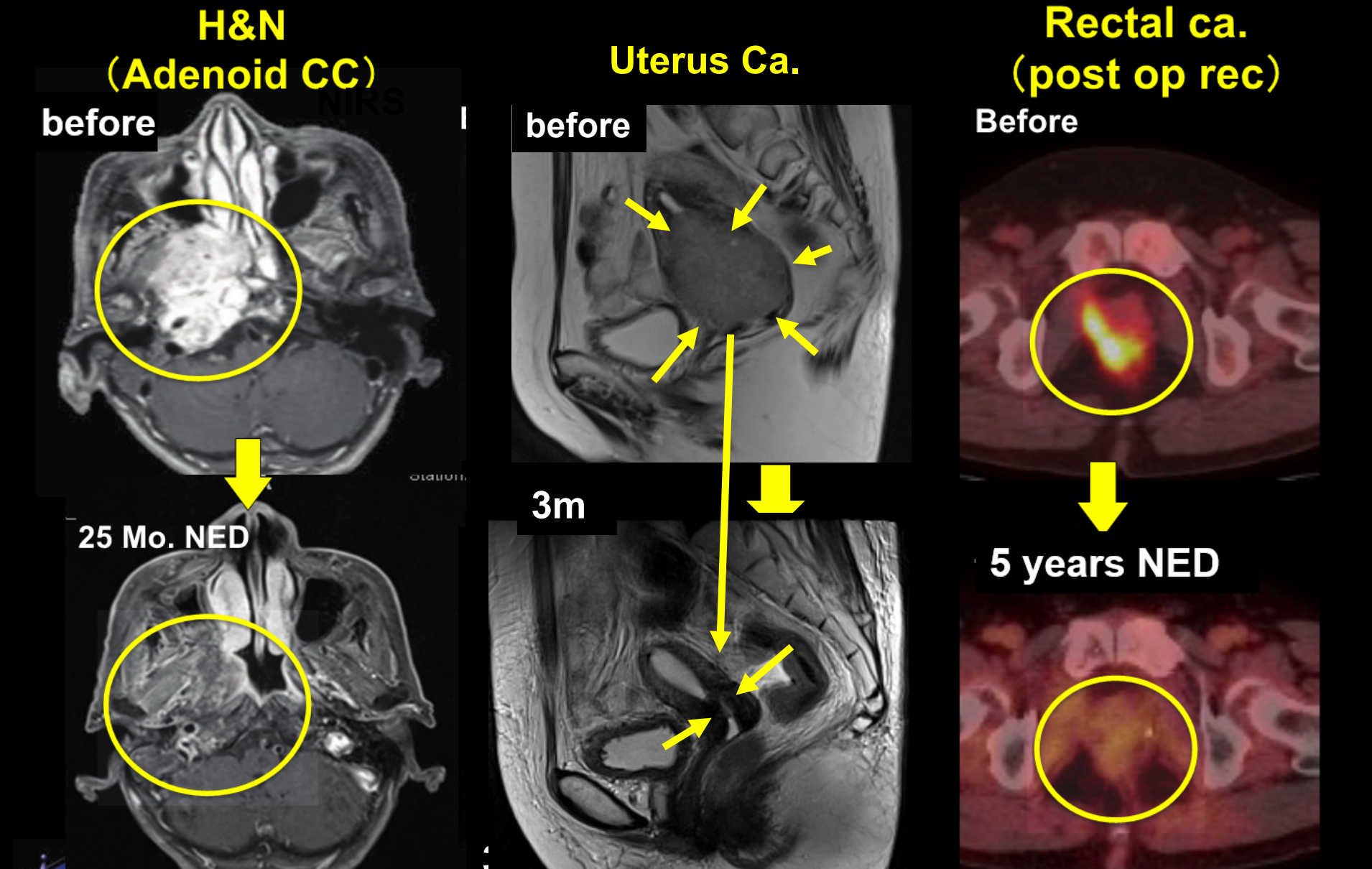
before



3y NED



Carbon therapy for radiation resistant tumors inoperable



Summary of Advantages of C-ion RT

・Dose distribution is better than protons in broad beam and scanning beam irradiation.

→ Less toxicity

・Radiobiological benefit has been confirmed for photon-resistant tumors including:

・Locally advanced large tumors (hypoxic tumors)

・Non-squamous cell type of epitherial tumors

・Sarcomas

→improving Local Control

・Wider range of clinical indications has been demonstrated.

→in Sarcomas, Rectal ca, Pancreas ca

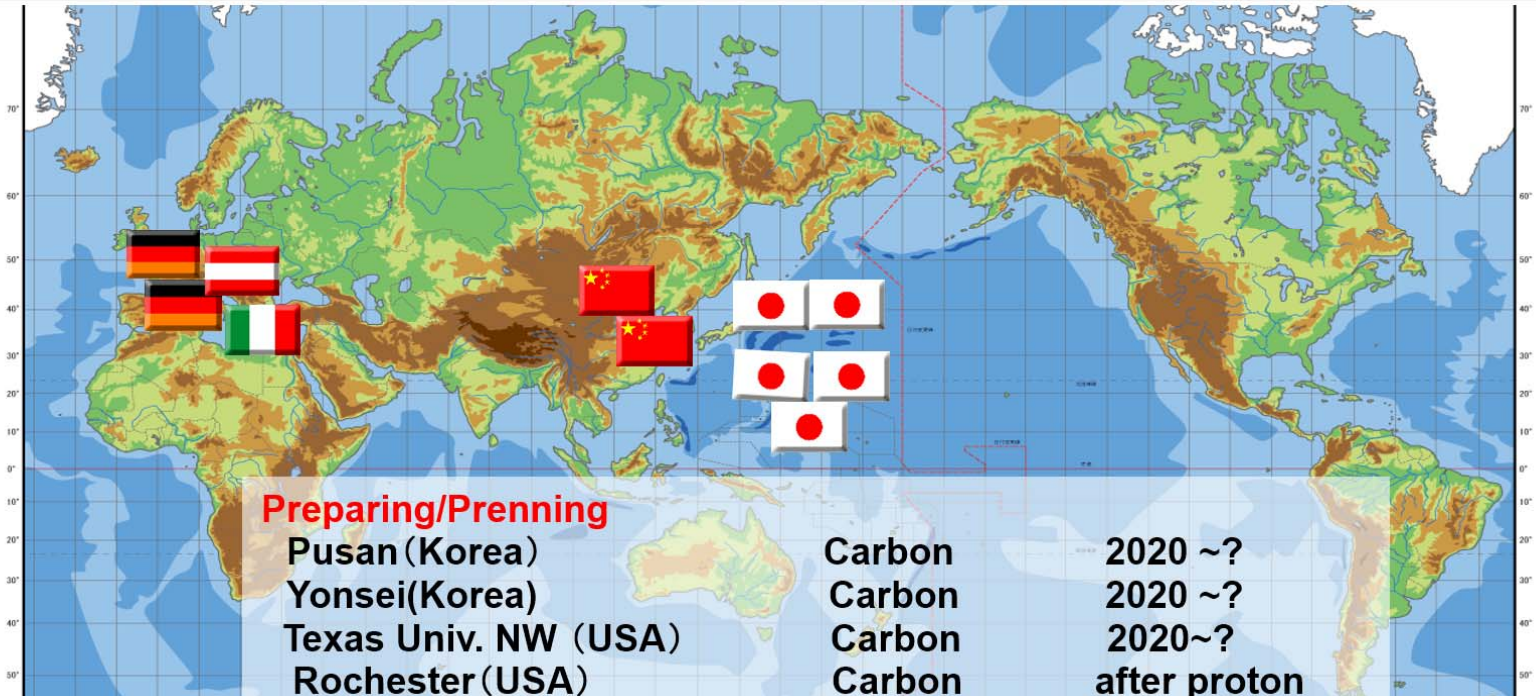
・Hypofractionated short treatment has been feasible in almost all tumors.

→Less burden on and less social disturbance for the patients

→Economically more advantageous to treat many patients / year

Heavy Particle Therapy Institution

Site	Beam	Period	
Chiba/NIRS (Japan)	Carbon	1994~	
Hyogo (Japan)	Carbon/Proton	2002~	
Lanzhou (China)	Carbon	2006~	
Heidelberg Univ. (Germany)	Carbon/Proton	2009.11~	University
Gunma Univ. (Japan)	Carbon	2010.3~	
Pavia (Italy)	Carbon/Proton	2012~	
Saga(Japan)	Carbon	2013.8~	
Shanghai(China)	Carbon/Proton	2014~	
Marburg (Germany)	Carbon/Proton	2017~	
Wiener Neustadt (Austria)	Carbon/Proton	2017~	
Kanagawa (Japan)	Carbon	2016	



Thank you for your attention!