ID	Presentation Title	Speaker	Question	Answer
01-01	History of Particle Therapy	Hirohiko Tsujii	Could you please explain the meaning of the word "pats" that you are using in your presentation? what are the main differences between cyclotron and bevatron? Based on your clinical experience what do you is the most promising ions except from carbon ions for future cancer treatments?	Q2-1. Could you please explain the meaning of the word "pats" that you are using in your presentation? It is an abbreviation for “patients”. Q2-2. what are the main differences between cyclotron and bevatron? This would be better answered by a physics expert rather than me, so I asked Dr. Shirai, Director of the Physics and Engineering Department, to answer the question. It is as follows. A cyclotron is an accelerator that uses large electromagnets to accelerate charged particles. The particles are held to a spiral trajectory by a static magnetic field and accelerated by an RF electric field. Cyclotrons are used for proton therapy using 200 MeV protons, but not for heavy-ion therapy, which uses 5000 MeV carbons. Because of high energy carbons, the electromagnet required are thousands of tons or more and are too large. The Bevatron was an accelerator and a kind of synchrotron used at Lawrence Berkeley National Laboratory, USA, which began operation in 1954. A synchrotron is a cyclic particle accelerator, in which the particles to be accelerated travels around a fixed closed-loop path. The electromagnets for the synchrotron are distributed along the fixed beam path and are not large in size. It is suitable for accelerators of high energy and heavy ions. The Bevatron was shut downed in 1990's, but all carbon radiotherapy facilities in the world adopt synchrotron at present. Q2-3. Based on your clinical experience what do you is the most promising ions except for carbon ions for future cancer treatments? I would use oxygen ions and helium ions alone or in combination for future cancer therapy. Oxygen ions have a higher RBE than carbon ions, and their Peak-to-Plateau ratio in RBEs would be a little higher than carbon ions, and above all, oxygens are essential for living organisms or humans and the name “oxygen” sounds good.
01-01	History of Particle Therapy	Hirohiko Tsujii	Thank you for your presentation. I understand that the carbon ion is a good choice for radiotherpy. If we have plan to evaluate some other ion beams except carbon ion. Which ions could be good candidates? Could you give us some suggestions? Thank you.	Please refer to Question 2.
01-01	History of Particle Therapy	Hirohiko Tsujii	Why are only carbon ions called heavy particle ions?	To my knowledge, there is no internationally accepted name for particle beams. Radiotherapy with carbon ions began in Japan in 1994, and since the time of construction project 10 years earlier, carbon ions have been referred to as heavy particle or heavy ions from the standpoint of radiation therapy, which was followed by some others worldwide. From a physics standpoint, however, carbon is rather referred to as light particle, and hadron therapy is often used instead of ion beam therapy. Thus, it would be better to use the individual particle name such as “Carbon ion radiotherapy” to be precise.

ID	Presentation Title	Speaker	Question	Answer
01-01	History of Particle Therapy	Hirohiko Tsujii	Why carbon ion is preferred than other particles	We have historically known that, whatever the radiotherapy modality used, improved dose distribution and proper disease selection are the primary factors in improving clinical outcomes. In this respect, charged particles like carbon ions and protons are ideal because they exhibit improved dose distributions due to their Bragg peak properties. In addition, carbon ions provide a higher biological effectiveness that is advantageous in treatment of photon-resistant tumors. Among various types of ion species, carbon ions have been selected for the following reasons. 1.Superior dose distribution of carbon ion beams: When comparing dose distributions of carbon ion and proton beams in treatment using two or more multiple fields, the distribution of carbon ion beams is superior in most cases. This is because the Coulomb scattering and range straggling are smaller for carbon ions than for protons, hence the penumbra is narrower and the lateral fall-off around the target volume becomes more rapid in CIRT, in spite of the low-LET fragmentation tail produced beyond the carbon-peak (Raju 1976). 2. Among various types of ion species, carbon ions were chosen because they were considered to be the "best balanced" particles in terms of biophysical properties: In carbon-ion irradiation, ionization density increases with depth, reaching the maximum at the end of the beam's range, thereby the LET/RBE increases as carbon ion beams travel deeper in the body. Biological experiments have shown that the peak-to-plateau ratio in RBEs is highest for carbon ions and that the OER for this peak is compatible to high-LET fast neutrons (Chapman 1976, Raju 1978). This means that the normal tissues in the plateau region receive radiations with lower biological effect, while the cancer lesions in the Bragg peak are exposed to larger physical doses of radiation with higher biological effect. The above is exactly the rationale behind why CIRT has been considered to be most suitable for cancer therapy. Some of representative outcomes confirming the benefits of CIRT are as follows. Since 1994, CIRT has been shown to be effective in various types of photon-resistant cancers, which is presented in this issue of ITCCIR 2021. Biological experiments have shown that the therapeutic ratio increases, but not decreases, even though the fraction size (dose per fraction) was increased. Based on this biological background, we have shown that hypo-fractionated RT is feasible for almost all types of tumors in clinical practice. Long-term observation of prostate cancer treated with CIRT showed that the risk of secondary malignancies was not high as was thought (Mohamad 2019). This may be due to the fact that the amount of secondary neutrons generated per a given physical dose is not high or even smaller than with other types of radiations (Yonai 2008).
01-02	J-CROS activities in Japan	Hiroshi Tsuji	(continued question 1) In case that you need to irradiate prostate+lymp nodes you use the same dose-fractionation as you mentioned,right?	Actually, we do not perform the pelvic LN irradiation for the prostate cancer. Instead, we apply the combined treatment of carbon-ion therapy and hormone therapy to the intermediate or high risk patient. At present, the outcomes are satisfactory, so we don't think the prophylactic pelvic LN irradiation is necessary. However, it is possible to apply to the very high risk patient as a new treatment strategy. In case we perform such treatment in future, we will use a little lower dose to the LN region, e.g. 48.0Gy RBE/12fr. which is confirmed safe in the carbon-ion therapy for the gynecological cancer.
01-02	J-CROS activities in Japan	Hiroshi Tsuji	I was wondering why do you use the same dose-fractionation for all prostate cases (localized and metastatic)? Can someone enroll to J-CROS from other country?	Thank you for the question. First, we do not treat the metastatic prostate cancer. If you mean high-risk prostate cancer, we could obtain very good result in this group, so we think it is not necessary to increase the dose. Thank you for the question. It is not possible for the institute from outside Japan, to join the J-CROS at present.
01-03	Cost effectiveness of CIRT	Tatsuya Ohno	Cost effectiveness or cost benefit ratio which is better to use	Thank you for your question. I think "cost effectiveness" is commonly used as an academic term.
02-01	Characteristics of Carbon ion Radiotherapy in cancer therapy	Marco durante	In the mouse study, there is no much difference between c ion + IT vs XRT+IT. Comment on it please	Immunotherapy alone is already quite effective so the difference becomes small. Yet C-ions alone are almost as effective as immunotherapy.
02-01	Characteristics of Carbon ion Radiotherapy in cancer therapy	Marco durante	Among various human cells what are the most sensitive to cabon ions irradiation? Based on your clinical experience which one do you think is the most promising ions except from carbon ions for future cancer treatment? Taking into account cost effectiveness. Is Carbon ion arc therapy feasible like proton arc therapy?	Radiosensitivity is independent of radiation quality. However, the RBE increases for low alpha/beta ratio, so radioresistant tumors are candidates for C-ions It is probably not a single ions, but a combination of light+heavy ions that can make the difference In principle less, but heavy ion gantry are so heavy that it is more feasible with the patient in vertical position
02-02	Role of heavy-ion-induced free radicals	Ryoichi Hirayama	What is the possibility (cross section) of a carbon ion beam to cause double strand brake of DNA? Is it always 100%?	Yes, I think the cross-sectional area is important. At that time, I think it is necessary to consider the track structure such as the cross-sectional area due to OH radicals.
02-05	DNA damage and cell killing effects by high-LET particle beams	Atsushi Shibata	What is the possibility (cross section) of a carbon ion beam to cause double strand brake of DNA? Is it always 100%?	We still do not know the frequency of DSB induction along the track. At the cellular level, some biological data suggest that it cannot be 100%. So the frequency of DSB induction could be dependent on chromatin structure, O2 concentration, and H2O concentration etc.

ID	Presentation Title	Speaker	Question	Answer
02-05	DNA damage and cell killing effects by high-LET particle beams	Atsushi Shibata	what is the clear definition clustered DNA Damage and how a DNA damage can be considered as a clustered DNA damage ?	The definition of clustered 'DSB' is that multiple DSBs are formed within a limited area after high LET irradiation. In our paper, we did not clearly define the number of DSBs and the size of the area, but generally, we call as it a cluster when the number of DSBs is >3 within 1 um3. https://pubmed.ncbi.nlm.nih.gov/30476166/ https://pubmed.ncbi.nlm.nih.gov/29312614/ N.B. Clustered 'DSB' is not the same as clustered DNA damage. When multiple DNA damage within a few nanometer is formed after high LET, we call it "complex DNA lesion", whereas clustered 'DSB' just contains DSB (DNA double strand break).
02-06	Immune Radiotherapy	Noriyuki Okonogi	Do you believe that someday immunotherapy and radiotherapy will merge as one against the fight of cancer with better therapeutic results or replace it?	Thank you for your question. I'm sure of it. As in the PACIFIC trial, the combination of radiotherapy and immune checkpoint inhibitors (ICIs) shows high efficacy. As a result, for non-small cell lung cancer, the standard of care has been replaced for the first time in about 20 years. Considering the large number of clinical trials of ICI combined with radiotherapy, this trend is likely to spread to other diseases. The evaluation of the long-term toxicity of these combinations and the analysis of predictors of therapeutic efficacy will be advanced in the future.
02-07	Targeted Radionuclide Therapy	Sumitaka Hasegawa	Do you belive that TAT&Theranostics in the future could be the "Holy Grail" in the fight against cancer? Can TRT combined with nanotechnology producing better therapeutic results? I was wondering if there is a data base in Japan or worldwide taking into account or measuring the toxicity of surrrounding healthy tissues-organs (OAR) using TRT. I think it is a hot topic.	I believe that TAT&Theranostics will be an effective therapeutic strategy in, at least, some cancers in the future. As you know, how precisely we can deliver therapeutic radioisotopes to your target is critical for success of TRT. In this point, more precise drug delivery system is critically needed. I believe that nanotechnology will surely improve current TRT to obtain better therapeutic results. It is a very important issue to accelerate TRT. I agree it is a hot topic and we should build a system to collect safety data worldwide.
02-08	FLASH Particle Therapy	Taku Inaniwa	What is the theoretical maximum dose that we can deliver in a tumour taking into account toxicity using Flash?	How much dose can be delivered to a tumor without causing toxicity on normal tissues depends heavily on how much FLAHS can spare the normal tissues. This is what we have to investigate through animal experiments using FLASH carbon beams,
02-08	FLASH Particle Therapy	Taku Inaniwa	Finally minibeam Flash Therapy that you introduced meets the Flash conditions? If I remember, there is significant improvements in minibeam Flash Therapy taking place at Marie Curie Institute in Paris.	Alhtough it is too early to affirm, but I suppose that the "SOBP" minibeam meets the FLASH conditions. We will investigate whether the SOBP minibeam meets the FLASH conditions or not through animal experiments in near future.
02-08	FLASH Particle Therapy	Taku Inaniwa	May you explain the difference between transmission field and conformal field?	The transmission field is the treatment beam with a very high energy that can penetrate through the patient's body. Since the transmission beam uses the plateau region of Bragg curves to cover a tumor volume, it is impossible to accumulate dose to the tumor volume with a single beam direction. In contrast, the conformal field is the conventional treatment field that cover the tumor volume by a SOBP of a single directional beam.
02-08	FLASH Particle Therapy	Taku Inaniwa	is there any limitation in term of tumor size for FLASH RT ?	The tumor size that can be treated with carbon FLASH (~10 Gy, ~40 Gy/s) is limited by the number of carbon ions that can be accelerated in a single synchrotron repetition cycle. The number is about 10^10 carbon ions at HIMAC with a perimeter of 130 m, and the maximum treatable tumor size is about 150 cc. If you use smaller synchrotron, the treatable tumor size will be smaller.
03-01	Accelerators for CiRT and Quantum Scalpel	Toshiyuki Shirai	Could you explain what do you mean with the word "quisi-continious" in your presentation (slide 13)? What are the main advantages of a laser driven accelerator compared to a conventional? In slide 7 why in some gaps you decelerate ions? I was wondering how you will deliver multi-ion to a patient. The multi-ion beam will be continuous. For example, you will deliver firstly carbon beam then He and afterwars Oxygen.Could please explain it in detail? Can a TPS optimize a dose distribution coming from more than one ion (eg Carbon) using multi-ion? That would be so complicated? PS: Ironman would be so proud ! You are approaching his superconducting synchrotron on his chest with Quantum Scalpel !!	A beam from a synchrotron has a ripple (see Figure1.jpg). Therefore I called it quasi-continuous. The advantage of the laser accelerator is a compactness. It consists of only a laser and target system without the large acceleration cavity and the power amplifier of the conventional linac. In the conventional linac, we use the RF (AC) electric field for the acceleration. Therefore, both of the acceleration and deceleration field appear at the same time. As you pointed out, the multi-ion therapy is an extension of the Intensity modulated ion therapy (IMIT). We irradiate carbon-ions at first and then irradiate oxygen-ions and helium-ions sequentially. Our TPS can optimize the dose distribution and the LET distribution with multiple-ions.

ID	Presentation Title	Speaker	Question	Answer
03-02	Beam delivery, QA and Radiation protection	Shunsuke Yonai	Which of the three beam delivery techniques are used clinically? In the scanning beam delivery when a specific spot (voxel) is intersected partially by the tumour and healthy tissue,how the system decide how much fluence should deliver?	Let me confirm your first question. You mean three beam delivery techniques to make depth dose distribution? or lateral dose distributions? As for your second question, the beam position, energy, and fluence are actually determined in the TPS system in order to obtain the optimal dose distribution.
03-02	Beam delivery, QA and Radiation protection	Shunsuke Yonai	(continued question 1) Sorry, I was not so precise. I was referring for both dose distribution (depth and lateral).	Three techniques for depth dose distribution have been used in clinical. At QST–NIRS, the range shifter and hybrid scanning techniques were employed in 2011 and from 2012 to 2015, respectively. The energy scanning technique has been employed since September 2015. For lateral dose distribution, spot scanning and raster scanning methods have been used in clinical. Currently, most of the CIRT machines, including QST, use the raster scanning method.
03-02	Beam delivery, QA and Radiation protection	Shunsuke Yonai	Thank you for your presentation. In your study, the PHITS code is used in simulaiton study. I also use PHITS in our simulation study, it is a very good simulation tool. In addition to PHITS, is there any other simulaiton tool used in the simulation work of QST? Thank you.	Thank you for your question. We use GEANT4 for beam modeling and biological effectiveness.
03-03	Treatment Planning, Biological models	Naruhiro Matsufuji	Have you incorporate the Japanese model in your TPS for RBE ?	Yes, the "Japanese model" described here has been integrated into our treatment planning system and is used in our daily carbon-ion radiotherapy. There are also commercially available treatment planning systems that incorporate this "Japanese model".
03-04	Treatment planning and Range uncertainty in CIRT	Nobuyuki Kanematsu	Would you mind explaining DECT method briefly?	CT number or photon-attenuation coefficient is a function of electron density and atomic number of matter as well as photon energy. Imaging an object twice with different photon energies (tube voltages), we obtain two CT numbers for each point in the object. Then, we can mathematically derive two unknowns that are electron density and atomic number. The two physical parameters, instead of a single CT number, will improve the accuracy of theoretical stopping power calculation for the object material, especially for non-standard tissues and artificial materials.
03-05	Motion management	Hideyuki Mizuno	During Phase control+Rescanning (PCR) when a specific spot intersect partially from the tumour and partially from healthy tissue how does the gating window optimize that spot? In that situation do you use smaller spot size?	The optimize is done during the treatment planning process. Each delineated volume (target/organ at risk (OAR)) is ranked in order of priority. The treatment planning system optimizes the dose according to the prescription dose to the tumor and the dose constraint to the OAR. During this process, 4D-CT data is used to assess the impact on OAR (healthy tissue), considering patient motion. If the calculated dose is acceptable, the plan is validated. Following this plan, the beam is irradiated using PCR.
03-06	IGRT with in-room CT	Makoto Sakai	Concerning future work: Do you think that Cherenkov radiation imaging can contribute to online dose calculation/confirmation system for safer treatment? I was wondering if you ever use Cherenkov radiation.	Carbon-beam irradiation to a water phantom produces visible lights. Although High energy particle beams and their secondary particles produce Cherenkov light, near the Bragg peak, the energy decreases and Cherenkov light is hardly generated [1]. However, Prof. Yamamoto of Nagoya Univ. has discovered a phenomenon of water luminescence that occurs below the Cherenkov light threshold. They have also succeeded in visualizing the Bragg peak using this luminescence phenomenon [2-5]. This phenomenon can be used to measure the particle trajectory in water phantoms, and may be used for QA. However, visible light does not penetrate the human body, so it cannot be used to measure the range or the dose during treatment. Ref: 1. Helo, Y., et al., The physics of Cerenkov light production during proton therapy, Phys. Med. Biol. 59, 7107-23, 2014. 2. S. Yamamoto, et al., Luminescence imaging of water during proton-beam irradiation for range estimation, Medical Physics, 42(11), 6498-6506, 2015. 3. Yabe, T, et al., Estimation and correction of produced light from prompt gamma photons on luminescence imaging of water for proton therapy dosimetry, Phys. Med. Biol. 63, 04NT02, 2018. 4. S. Yamamoto, et al., Luminescence imaging of water during carbon-ion irradiation for range estimation, Med. Phys. 43, 2455-2463, 2016. 5. T. Yabe, et al., Addition of luminescence process in Monte Carlo simulation to precisely estimate the light emitted from water during proton and carbon-ion irradiation, Phys. Med. Biol. 63(12):125019. 2018.
03-07	Facility design of Yonsei Cancer Center, Korea	Jin Sung Kim	May I ask to explain how do QA for such many energy steps? Are there any special devices or methods with spatial resolution more than 0.5 cm?	Thank for good question. Basically we are going to measure the energy with ion chamber based QA system in the commissioning stage and it will take the heavy measurement time. However it is good for patient and staff to have many options to use many energy steps. After commissioning, we will check the consistency using multi-chamber type QA device (Zebra, Giraffe, Peakfinder and etc) and we also think it will be possible to move a little bit to measure 0.5cm resolution.
03-08	Facility commissioning at Osaka-HIMAK	Masaaki Takashina	I have heard a lot of times about lowest energy of accelators. You mention it too. That energy is 100Mev/u.I was wondering if that value is constatnt for all accelerators or unique for every specific machine. What parameters determine the lowest energy for each accelerator? If we use lower than that value the accelerator will not be able to deliver the therapeutic beam?	The lowest accelerated energy depends on facilities. Indeed, those of QST and several facilities should be lower than 100 MeV/u, because they adopt full energy scanning technique for range modulation. The range of 100 MeV/u is about 2cm in water, and is not sufficient to treat shallow tumors, e.g. soft tissue and bone sarcomas. The lowest energy of carbon ion therapy facility with full energy scan may be about 70 MeV/u that corresponding to the range of 5mm in water. In our facility, the energies lower than 100 MeV/u are realized with range shifter.

ID	Presentation Title	Speaker	Question	Answer
03-09	Facility commissioning at Yamagata	Hikaru Souda	You mentioned to the lowest energy (extraction energy) of 55.6 Mev/u.That value varies for each accelerator and why? How long does it take to commissioning of 600 energy layers? 4 Medical Physicists staff is adequate number for your workload? On which criteria setup script based on for plan check evaluation?	> You mentioned to the lowest energy (extraction energy) of 55.6 Mev/u.That value varies for each accelerator and why? The accelerator (synchrotron) can extract the beam even 20-30 MeV/u. The lowest energy is determined by beam transport and irradiation systems. Broad beam systems form SOBP of 2-14 cm by ridge filter, so the lowest energy for clinical use is generally higher than that of scanning systems, 140 MeV/u or 290 MeV/u are adopted. For scanning system, Low energy beams are easily scattered by dose/position monitor foils or air gaps, so the beam size at the low energy is quite large. If the beam penumbra is not tolerable for clinical use, a combination of higher energy and bolus-like range shifter is used to decrease the beam spot size. For less than 40 MeV/u, the beam range is less than 5 mm, it is too difficult to measure the beam size and depth dose. > How long does it take to commissioning of 600 energy layers? We did not fully commission all 600 energies. Beam position and size are checked and optimized for 600 energies, and detailed measurements of uniformity, depth dose, scanning spot precisions were measured 15-30 representing energies. Energies other than representing energies are totally checked by 3-dimensional irradiation and patient QA. Since the commissioning measurements and parameter optimization by the vendor were carried out in parallel, it is difficult to say the time for commissioning, about 3 month for the whole process. > 4 Medical Physicists staff is adequate number for your workload? Frankly speaking, No. I think 4 MP is enough for stable phase after commissioning completed, it is desirable to have 5-6 MPs for commissioning phase... > On which criteria setup script based on for plan check evaluation? Plan check by the script is formality check to find the human error. The criteria are setting of machine selection, margin setting, isocenter position (within 20 cm from CT origin), grid size (=2 mm), spot number(< 10,000,000), etc.
03-10	What Particle Therapy Can Learn from IMRT and Other High-Precision Radiotherapies	Arnold Pompos	Don't you think that oART is too time consuming taking into account so many parameters in a clinical level under pressure? Don't you think that daily CT in oART (CBCT,Fan beam CT etc.) will overdose the patients?	A1: Hello, thank you for this very relevant question. My answer is “not necessarily”. Let me try to explain. Every institution and every investigator and every clinician attempting to implement oART is thinking about the same question. If oART utilized classical/conventional treatment planning approach driven by humans, yes indeed, patient would be on the table too long, and human errors under time pressure could potentially prohibit oART success. However, modern oART systems rely heavily on sophisticated computer algorithms, including deep learning to mitigate these issues. Its been proven many times that if a computer can do a human task, it will do it better. oART is a perfect example where software is helping in every step. The claim is not that every single patient today would benefit from oART exactly for this reason of timing reason you brought up. The claim is that there is a large percentage of patient where currently achievable oART timings bring in theory significant benefit to the patient. Of course, this statement needs to be proven in well designed clinical trials comparing conventional approach with oART approach. Vendors providing oART solutions are well aware of the clinical needs and are making lots of progress to push the timings to levels that more and more patients can benefit from oART. A2: Hello, thank you for this very relevant question. My answer is “not necessarily”. The vendors of oART are well aware of this topic. They tune their imaging systems to provide sufficiently good imaging to be able to produce good enough daily contours and good enough daily dose calculations. They are not aiming at diagnostic quality high dose imaging. There are numerous low dose CBCT, fan beam CT protocols that in combination with deep learning provide sufficient imaging needs for oART. In addition, I would like to relate this question to hypofractionation. Adaptive radiation therapy makes the biggest impact on hypofractionated cases, where very high dose is being deposited and where reacting to anatomic changes is vital. Hypofrac approaches limit the overall treatment planning ionizing radiation exposure. The dose deposited by kV CBCTs and kV fan beam CT are of course not zero, but the clinicians judgment of cost versus benefit to the patients plays a vital role in oART success. The overall trend of thinking is, in many many cases IGRT uses daily volumetric imaging, so why not to use the acquired images for a higher course, such as oART.
04-01	Head & Neck tumors	Masashi Koto	Do you use image fusion (PET+CT etc.) for H&N treatment plans?	Thank you for your question. We usually use MRI-CT and PET-CT image fusion techniques for HN treatment plans.
04-01	Head & Neck tumors	Masashi Koto	I was wondering if you use auto contouring in your treatment plans.	Thank you for your question. Currently we don't use auto contouring system for both targets and OARs.
04-02	Choroidal melanoma and Malignant Lacrimal Gland Tumor	Masaru Wakatsuki	I was wondering if you treat retinoblastoma cases using CIRT and what are the treatment outcomes.	Since retinoblastoma is a radiosensitive tumor, we believe that C-ion RT is not necessary. Therefore, we have no experience in treating retinoblastoma.
04-03	Non-small Cell Lung Cancer	Mio Nakajima	I was wondering if it is feasible to use CIRT or conventional RT in order to irradiate Lung in patients with Covid.Especially in severe cases.Is that feasible and practical?	I think it is difficult to irradiate lung cancer patients with Covid as its risk is too high, because many of them have comorbidity, such as older age, COPD, lung fibrosis, heart disease, or etc. In the expert opinion from the Japan Lung Cancer Society, there is recommendation that radiotherapy for symptomatic patients should be postponed generally. For asymptomatic patients, radiotherapy would be possible, but careful assessment should be needed as lung reaction might be stronger than usual.
04-03	Non-small Cell Lung Cancer	Mio Nakajima	what can we do to reduce the risk of grade 3 pneumonitis in stage III NSCLC patients who undergo CIRT ?	It must be important to reduce lung dose same as X-ray irradiation. Especially when patients have lung fibrosis, the risk of severe pneumonitis is higher. We have to reduce low dose region as less as we can for such cases. Decreasing the number of ports or avoiding irradiating hilum region would work to reduce its risk.

ID	Presentation Title	Speaker	Question	Answer
04-04	Liver Cancer	Kei Shibuya	what kind of marker is used for patient with dense lipiodol deposition ?	If dense lipiodol deposition after TACE is visible in X-ray, we do not implant metalilc fiducial marker and use lipiodol as marker.
04-06	Bone & Soft tissue Sarcoma	Reiko Imai	is the tumor enlargement usually happens at the end of CIRT ? how you tell your patient about this ?	Thank you for the question of how to tell the enlargement of the tumor after CIRT to patients. We talk as it is and patients could understand it.
04-06	Bone & Soft tissue Sarcoma	Reiko Imai	I was wondering if you use CIRT to treat blood cancers such as leukemia. If not,why? What are the indications in order to reject a treatment such as CIRT in a case of blood cancer? What is the best treatment for blood cancers?	Thank you for the inquiry of CIRT for blood cancer. Chemotherapy and systemic treatment are the best for blood cancer.
04-07	Carbon-ion Tx for prostate cancer and renal cancer	Hitoshi Ishikawa	From dose coverage and rectal bleeding perspective how do you approach overlapping regions between PTV and rectum?	The dose to overlapping regions are reduced to 85% of the prescribed dose by inverse planning
04-07	Carbon-ion Tx for prostate cancer and renal cancer	Hitoshi Ishikawa	what margins do you use?	10mm lateral, 7mm anterior, 6mm HI, 5mm posterior
04-07	Carbon-ion Tx for prostate cancer and renal cancer	Hitoshi Ishikawa	Can prostate cancer treated with one single fraction? Is there any theoretical barrier to that direction?	If the urethral dose is reduced efficiently, single fraction will be accepted.
04-07	Carbon-ion Tx for prostate cancer and renal cancer	Hitoshi Ishikawa	Do you use Simultaneous Integrated boost (SIB) in prostate cancer using CIRT?	We have no experience of SIB for prostate cancer, but it is interesting.
04-08	Locally recurrent Rectal cancer	Hirotoshi Takiyama	Is there any other risk factors of > grade 2 AEs beside prior X-ray therapies ?	This is just our impression, but it seems that adverse events are more common in cases where anti-VEGF or anti-EGFR antibodies are used.
04-08	Locally recurrent Rectal cancer	Hirotoshi Takiyama	CosT of absorbable spacer	It's almost 500K JPY (= 440K USD) per sheet, 10cm*20cm.
04-09	Gynecological	Kazutoshi Murata	HDR Brachytherapy is not a good treatment for centrally located Gynecological tumours?	When performing carbon ion radiation therapy for cervical cancer with advanced uterine body invasion, it is often difficult with sufficiently reduced doses to the surrounding risk organs. In such cases, Brachytherapy is likely to deliver a sufficient dose to the target volume while reducing the dose to the surrounding organs at risk. However, Brachytherapy is a treatment with low-LET beams. Therefore, it is necessary to study which cases the combination of Brachytherapy and carbon ion radiation therapy is effective.
04-09	Gynecological	Kazutoshi Murata	do you have any experience regarding the use carbon ion as therapy for gynecologic malignancy relapse ?	Yes, we have experience with carbon beam therapy for recurrent gynecologic tumors. We have treated postoperative vaginal stumps in a few cases in the past. We also have experience treating recurrences in the pelvic and para-aortic lymph node areas. We determine the indications for reirradiation based on the past irradiation history and the anticipated radiation dose to the surrounding tissues.
04-10	Breast	Yasumasa Mori	can we perform carbon ion radiotherapy for every case of early stage breast cancer regardless the biological profile of the tumor ?	
05-01	Diagnostic PET imaging for CIRT	Ryuichi Nishii	I was wondering if there is any data base in Japan or worldwide taking into account or measuring the toxicity of surrrounding healthy tissues-organs (OAR) using TRT. Do you use any TPS in nuclear medicine?	
05-02	Value of Diagnostic Imaging after Carbon-Ion Radiotherapy (CIRT)	Riwa Kishimoto	Multi-parametric MRI: Could you please explain that technique (briefly)? What are the advantages and disadvantages?	Thank you for your question. Multiparametric MRI (mpMRI) combines anatomic T2W imaging with functional and physiologic assessment, including diffusion-weighted imaging (DWI) and its derivative apparent-diffusion coefficient (ADC) maps, dynamic contrast-enhanced (DCE) MRI, and sometimes other techniques such as in-vivo MR proton spectroscopy. The combination of these diagnostic images has Improved detection of clinically significant cancer, which is critical for reducing mortality, and has Increased confidence in benign diseases and dormant malignancies in order to reduce unnecessary biopsies and treatment. The disadvantage of mpMRI is the elongation of the examination time.
06-01	Overview of Proton Therapy	Hideyuki Sakurai	If you please, could you give us your opinion in prospective for pediatric cancer treatment by using CIRT?	Most of pediatric cancer shows high sensitivity of radiation. In this circumstances, CIRT is not necessary for the treatment. On the other hand, osteosarcoma in young patient, which is radioresistant, is very good candidate of CIRT.
06-01	Overview of Proton Therapy	Hideyuki Sakurai	Do you accept PhD candidates (Medical physicists) from other countries? what about the eligibility? Do you treat blood cancers such as leykemia with particle beams? If not, why?	Currently, we do not accept foreign researcher because of COVID-19. In Japan, hematological cancer is not candidate of proton therapy, except mediastinal lymphoma. I personally think lymphoma is very good candidate of PBT.

ID	Presentation Title	Speaker	Question	Answer
06-02	Rationale and Indications for CIRT at Mayo Clinic/USA	Robert L. Foote	Are they any indications of using CIRT in the treatment of blood cancers such as leukemia?	This is a very interesting question. I am not aware of any current indications for CIRT in the management of blood cancers such as leukemia. The role of radiotherapy in general is quite limited at this time in the management of leukemia and is used most often as a palliative treatment for symptomatic skin or nodal masses or infiltration of the CNS. Leukemia cells, in general, are quite radiosensitive to relatively low doses of photon radiotherapy, doses below the tolerance level of most organs at risk. Current indications for CIRT include patients with potentially curative solid tumor malignancies which are considered radioresistant to low LET, sparsely ionizing radiation therapy such as photons or protons and are located adjacent to radiosensitive healthy organs. Aggressive, localized, radioresistant, high grade lymphomas located in the head and neck, thorax, abdomen or pelvis adjacent to radiosensitive healthy organs would be a consideration for future clinical research. Thank you for asking this question.
06-02	Rationale and Indications for CIRT at Mayo Clinic/USA	Robert L. Foote	If you please, could you give us your opinion in prospective for pediatric cancer treatment by using CIRT?	Thank you for this question. Anita Mahajan is my colleague at Mayo Clinic who specializes in pediatric malignancies and particle therapy. She has shared her thoughts as follows: Any indication that would be suitable for adults would be an indication for the pediatric aged population, since the biology and radiosensitivity would be similar. This would include the following: • Bone sarcomas: unresectable osteosarcoma, some Ewing sarcomas (perhaps pelvic). These tend to be seen in the adolescent and young adult (AYA) age group. • Large, unresectable, non-rhabdomyosarcoma, similar to adult indications, especially in AYA age group. Maybe not for infants. • Brain tumors: there is less convincing evidence for brain tumors, but possibly skull base tumors or aggressive meningiomas. We have not seen convincing evidence of better tumor control, but the time efficiency/shorter overall treatment time is an advantage to the child and their family. We would need to be very cautious with late effects of normal structures within or in contact with the gross tumor volume. • Head and neck: similar indications as for adults, for example, mucosal melanoma and adenoid cystic carcinoma, but these are rare in the pediatric/AYA population. • Recurrent disease: in carefully selected pediatric/AYA patients with local control issues and radioresistant tumors. • Metastatic disease: oligometastatic, radioresistant malignancies. I hope that this information is helpful.
06-03	Overview of BNCT & Current status of Accelerated-based BNCT	Yoshihiro Takai	Have you ever used nanoparticles in order to increase ever more the concentration of boron-10 compounds to cell tumours? Are they any clinical trial for eye cancers? Are there any other radioisotope like Bron-10 with similar physical properties?	
06-04	Radiation Emergency Medicine	Hideo Tatsuzaki	I was wondering if you use any emergency systems to warn (?) and protect you and facilities too from strong earthquakes.	No. We do not have any paricular warning system. Some of our staff have ordinal warning from handy phone, which detect earthquake at some distance and warn several seconds before real termbling, but this is same system as ordinal people. H. Tatsuzaki
07-01	Toshiba Corporation	Toshiba Corporation	Could you explain please the meaning of "LET painting" that you use in your presentation?	Linear energy transfer (LET) is known to exhibit correlation with OER and RBE. LET painting, in my understanding, means a method to optimize the dose-averaged LET distribution for hypoxia tumor in which higher LET value is particularly needed on a hypoxia region for treatment. Multi-ion radiotherapy using several different ion species would be a practical way to control the LET distribution. I appreciate it if you refer the meaning of LET painting to some medical physics papers also.
07-02	Hitachi, Ltd.	Hitachi, Ltd.	Concerning FLASH therapy. What are the main parameters that you are taking into account as for radiation shielding compared to a conventional system?	The amount of beam loss and its energy, which includes the irradiated particle to the patients, within the specified time duration should be taken account into shielding in both system with and without FLASH therapy. In the case of synchrotron-based FLASH with variable energies, the beam energy and averaged beam current can be kept same level from conventional ones, so less concern to the radiation shielding. The impact of the instantaneous beam current to the radiation shielding is depending on the regulations in each region or country.