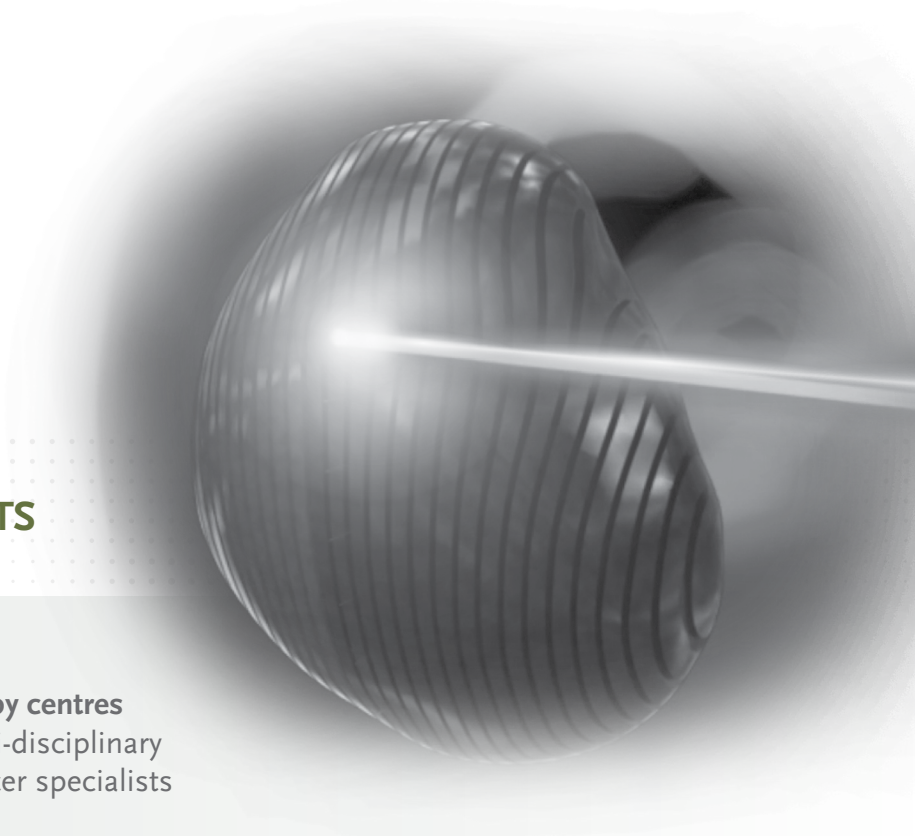
IHH Healthcare

RADIATION ONCOLOGY

Proton Therapy



KEY PROCEDURE HIGHLIGHTS

1. **One of the first Proton Therapy centres in Southeast Asia** with a multi-disciplinary and experienced team of cancer specialists

2. **Highly precise radiation therapy** allows for sparing of healthy tissues and organs [2,3,4]

3. **Reduced risk of radiation-induced malignancy** in young people [1]

4. **Significantly lower risk of adverse side effects** and toxicity [2,3,4,10,11]

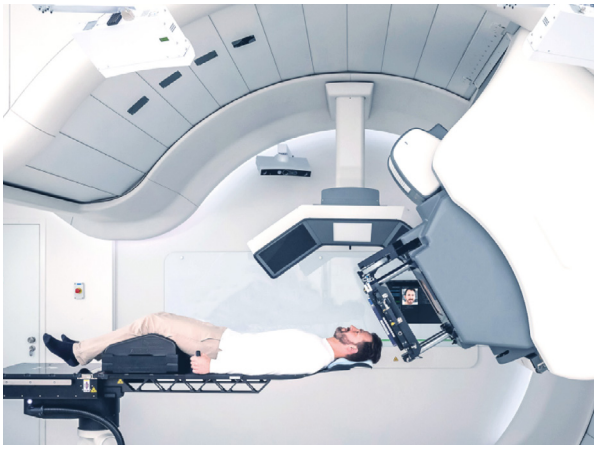
Gleneagles Hospital SINGAPORE | Mount Elizabeth™ ORCHARD | Mount Elizabeth™ NOVENA | Parkway East Hospital

PROTON THERAPY

Mount Elizabeth Hospitals offer a wide range of personalised radiation treatments, including

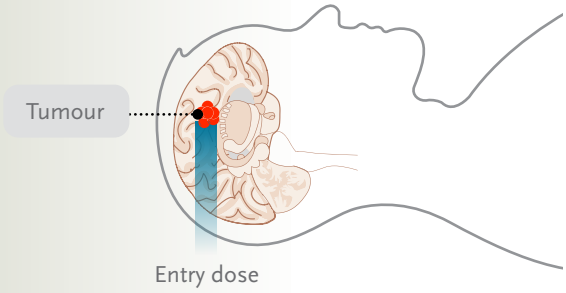
- linear accelerator-based radiation (photons & electrons)
- gamma knife
- brachytherapy
- proton therapy

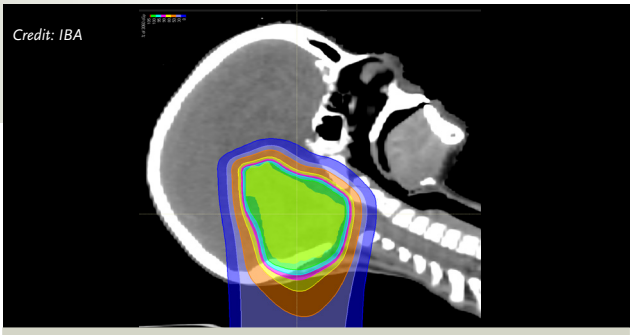
Proton therapy is an advanced and highly precise radiation treatment to destroy tumour cells. It delivers minimal entrance radiation and no radiation beyond the intended tumour as compared to traditional photon therapy.



PROTON THERAPY VS PHOTON THERAPY

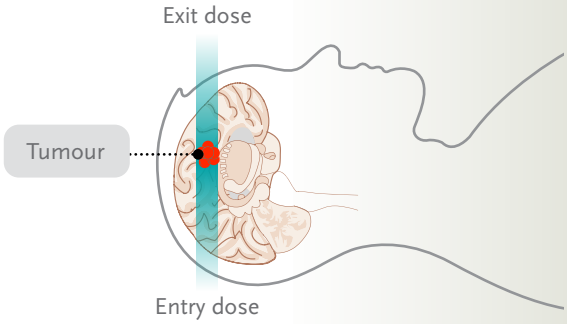
Proton Therapy

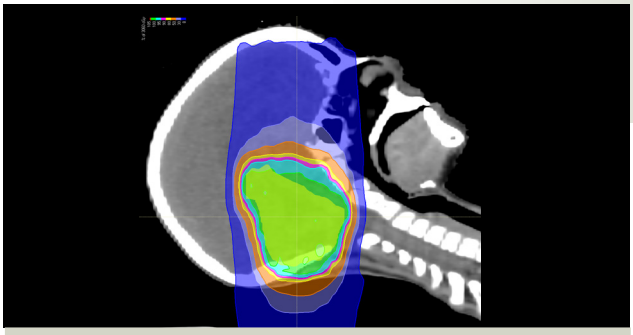




- Positively charged particles
- Deposits energy at a prescribed depth within the tissues with no exit dose

Photon Therapy





- Electromagnetic energy
- Deposits energy through the body with an exit dose

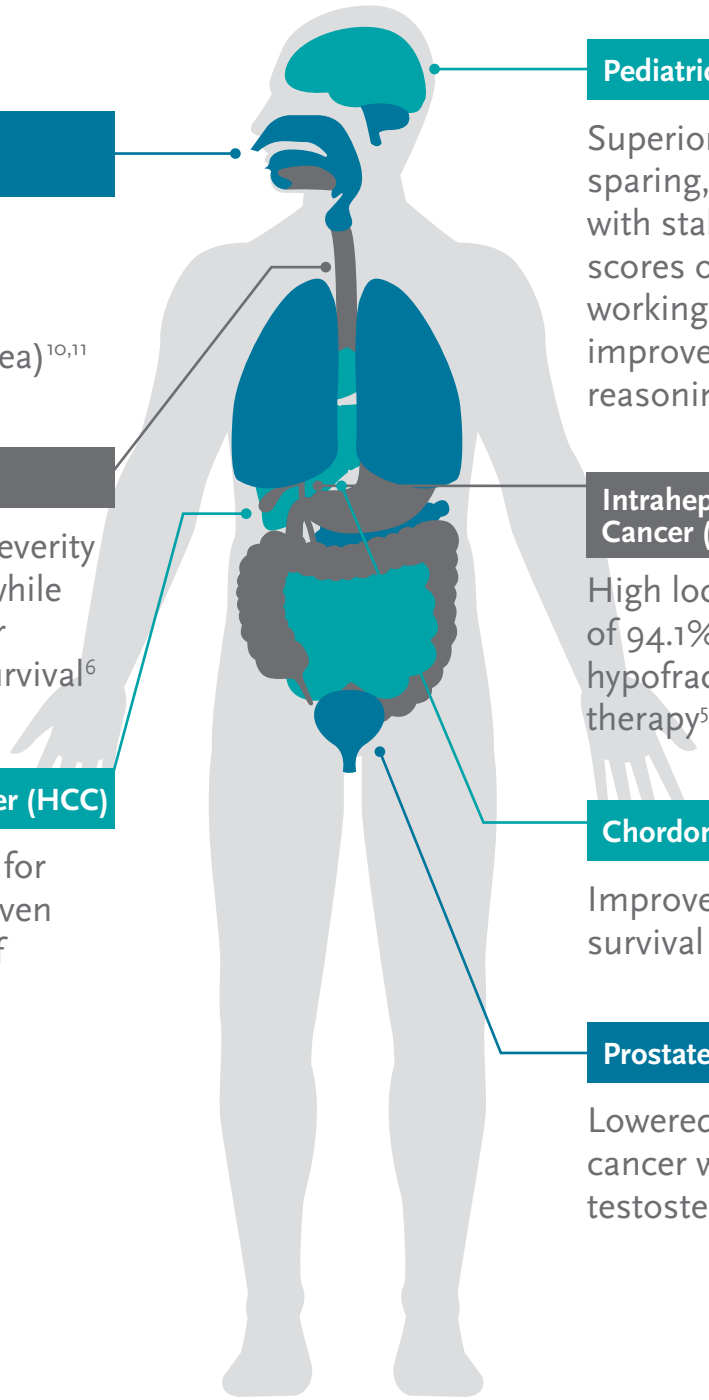
With no exit dose, proton therapy spares the surrounding organs and healthy tissues, offering potential advantages over photon therapy.

- Minimise radiation to healthy tissues[10,11]
- Significantly higher survival rates in various tumours[17]
- Potentially reduce risk of secondary cancers[9]
- Potential quality of life improvement for patients[14,15,16]
- Allow for safe dose escalation associated with higher overall survival[8]

TREATMENT INDICATIONS

Proton therapy is beneficial in the treatment of a wide range of tumours, including: [7]

- Brain
- Oesophageal
- Gastrointestinal
- Gynaecological
- Head and neck
- Liver
- Lymphoma
- Prostate
- Soft tissue
- Spine
- Young adults and children



Nasopharynx and Oropharynx Cancer

Fewer and less severe side effects (e.g., dysphagia, odynophagia, nausea)[10,11]

Oesophagus Cancer

Reduced risk and severity of adverse events while maintaining similar progression-free survival[6]

Hepatocellular Cancer (HCC)

Alternative therapy for inoperable HCC, given greater precision of proton delivery[2]

Pediatric Medulloblastoma

Superior intellectual sparing, associated with stable global IQ scores over time, stable working memory, and improved perceptual reasoning scores[16]

Intrahepatic Cholangio Cancer (ICC)

High local control rates of 94.1% with high dose hypofractionated proton therapy[5]

Chordomas

Improved overall survival rates[8]

Prostate Cancer

Lowered risk of secondary cancer with no effects on testosterone levels[9,12]

TREATMENT PROCESS

At Mount Elizabeth Hospitals, we have a multidisciplinary team of experts to manage proton therapy for our patients. Our multidisciplinary team of cancer specialists includes surgical, medical, radiation oncologists and hematologists, supported by radiation therapists, physicists, nurses & allied health professionals - all dedicated to help patients fight cancer.

Many of our physicians and physicists are highly established experts in the field of radiation therapy, ready to deliver the best possible care experience and outcomes based on patients' individual needs.

TREATMENT PROCESS FLOWCHART

1 BEFORE TREATMENT

Pre-preparation information is provided to patient, which may include emptying bowels and adhering to specific diet. Patient will undergo a treatment planning process called **simulation**.

a. The radiation treatment team will measure and mark on the patient's body where radiation will be targeted.

b. The simulation takes approximately 1 hour and the patient should not feel any discomfort.

c. Images of the simulation are used to design the patient's treatment with customised plan and an optimal way of treating each individual patient.

2 CLINICAL REVIEW AND QUALITY ASSURANCE

The radiation oncologist will work closely with the physicist to determine the best possible radiation dose distribution to the tumour, preserving the normal organs, and improving the quality of life. This process is simulated, optimised and calculated by a sophisticated treatment planning software with advanced algorithms.

Proton therapy may commence once the simulation result satisfies the clinical requirements and matches with the result of the patient-specific quality assurance measurement.

TREATMENT PROCESS

3 SET-UP

a. Patient will lie on the treatment table (in the same position used for simulation) in a personalised ambient lighting environment designed to make patients feel more comfortable during treatment.

b. Radiation therapists will align the markings on the patient's skin with the laser systems. Immobilisation devices customised in the simulation process will be used in the identical manner to reproduce the same patient position.

c. During each session, pre-treatment verification of the patient position (Image Guided radiation therapy) will be performed to ensure both the tumour position and shape is consistent before each treatment session.

d. When some changes in the tumour position and/or shape are identified, Adaptive Radiotherapy workflow will kick in to ensure the treatment is adapted to the latest changes in the patient.

4 RECEIVING TREATMENT

Once the patient is positioned and verified, the team will proceed to deliver the proton treatment from the treatment console. The whole treatment session will be actively monitored and the team can communicate with the patient through a CCTV in the control room.

5 REGULAR CONSULTATION AND EVALUATION OVER THE PROTON THERAPY TREATMENT COURSE

The radiation oncologist will meet with the patient weekly, over the course of the treatment, to review the care progress, address any of the patient's queries and plan for future treatments. The treatment plan may be constantly adjusted throughout the therapy.

6 FOLLOW UP CARE

Follow-up appointment(s) will be given to patient upon completion of proton therapy treatment course. Our specialists will monitor the recovery progress and provide patient guidance on follow up care.

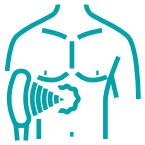
TREATMENT PROCESS

TYPICAL COURSE OF THERAPY

5 days a week,
up to 8 weeks

Treatment is typically
delivered within
5 minutes

30 mins pre-treatment
preparation and
positioning



Usually painless
and done in
outpatient setting

REFERENCES

1. Lim PS, Tran S, Kroeze SGC, et al. Outcomes of adolescents and young adults treated for brain and skull base tumors with pencil beam scanning proton therapy. Pediatr Blood Cancer. 2020;67(12):e28664. doi:10.1002/pbc.28664
2. Bush DA, Kayali Z, Grove R, Slater JD. The safety and efficacy of high-dose proton beam radiotherapy for hepatocellular carcinoma: A phase 2 prospective trial. Cancer. 2011;117(13):3053-3059. doi:10.1002/cncr.25809
3. Gunn GB, Blanchard P, Garden AS, et al. Clinical outcomes and patterns of disease recurrence after intensity modulated proton therapy for oropharyngeal squamous carcinoma. International Journal of Radiation Oncology*Biology*Physics. 2016;95(1):360-367. doi:10.1016/j.ijrobp.2016.02.021
4. Holliday EB, Garden AS, Rosenthal DI, et al. Proton therapy reduces treatment-related toxicities for patients with nasopharyngeal cancer: A case-match control study of intensity-modulated proton therapy and intensity-modulated photon therapy. International Journal of Particle Therapy. 2015;2(1):19-28. doi:10.14338/ijpt-15- 00011.1
5. Hong TS, Wo JY, Yeap BY, et al. Multi-institutional phase II study of high-dose hypofractionated proton beam therapy in patients with localized, unresectable hepatocellular carcinoma and intrahepatic cholangiocarcinoma. Journal of Clinical Oncology. 2016;34(5):460-468. doi:10.1200/jco.2015.64.2710
6. Lin SH, Hobbs BP, Verma V, et al. Randomized phase IIB trial of proton beam therapy versus intensity-modulated radiation therapy for locally advanced esophageal cancer. Journal of Clinical Oncology. 2020;38(14):1569-1579. doi:10.1200/jco.19.02503
7. Ministry of Health Singapore. Regulation of Proton Beam Services. MH 78:04/4-2 V15. MOH Circular No. 18/2021. Singapore; 2021.
8. Palm RF, Oliver DE, Yang GQ, Abuodeh Y, Naghavi AO, Johnstone PA. The role of dose escalation and proton therapy in perioperative or definitive treatment of chondrosarcoma and Chordoma: An analysis of the national cancer data base. Cancer. 2019;125(4):642-651. doi:10.1002/cncr.31958
9. Wu Y-Y, Fan K-H. Proton therapy for prostate cancer: Current state and future perspectives. The British Journal of Radiology. 2022;95(1131). doi:10.1259/bjr.20210670
10. Williams VM, Parvathaneni U, Laramore GE, Aljabab S, Wong TP, Liao JJ. Intensitymodulated proton therapy for nasopharynx cancer: 2-year outcomes from a single institution. Int J Part Ther. 2021;8(2):28-40. doi:10.14338/IJPT-20-00057.1
11. Holliday EB, Kocak-Uzel E, Feng L, et al. Dosimetric advantages of intensity-modulated proton therapy for oropharyngeal cancer compared with intensity-modulated radiation: A case-matched control analysis. Med Dosim. 2016;41(3):189-194. doi:10.1016/j.meddos.2016.01.002
12. Nichols RC Jr, Morris CG, Hoppe BS, et al. Proton radiotherapy for prostate cancer is not associated with post-treatment testosterone suppression. Int J Radiat Oncol Biol Phys. 2012;82(3):1222-1226. doi:10.1016/j.ijrobp.2010.12.025
13. Phan J, Sio TT, Nguyen TP, et al. Reirradiation of head and neck cancers with proton therapy: Outcomes and analyses. Int J Radiat Oncol Biol Phys. 2016;96(1):30-41. doi:10.1016/j.ijrobp.2016.03.053
14. Hoppe BS, Michalski JM, Mendenhall NP, et al. Comparative effectiveness study of patient- reported outcomes after proton therapy or intensity-modulated radiotherapy for prostate cancer. Cancer. 2013;120(7):1076-1082. doi:10.1002/cncr.28536
15. Verma V, Simone CB, Mishra MV. Quality of life and patient-reported outcomes following Proton Radiation Therapy: A systematic review. JNCI: Journal of the National Cancer Institute. 2017;110(4):341-353. doi:10.1093/jnci/djx208
16. Kahalley LS, Peterson R, Ris MD, et al. Superior intellectual outcomes after proton radiotherapy compared with photon radiotherapy for pediatric medulloblastoma. Journal of Clinical Oncology. 2020;38(5):454-461. doi:10.1200/jco.19.01706
17. Ohnishi K, Ishikawa H, Nakazawa K, et al. Long- term outcomes of high- dose (74 GyE) proton beam therapy with concurrent chemotherapy for stage iii nonsmall- cell lung cancer. Thoracic Cancer. 2021;12(9):1320-1327. doi:10.1111/1759-7714.13896

IHH Healthcare

IHH Healthcare has a global network of 83 hospitals and ancillary services in 10 countries.

As a patient at Gleneagles Hospital Singapore, Mount Elizabeth Hospital, Mount Elizabeth Novena Hospital and Parkway East Hospital, you enjoy easy access to a full spectrum of integrated healthcare services under the IHH Healthcare ecosystem.

For more information, contact us at: