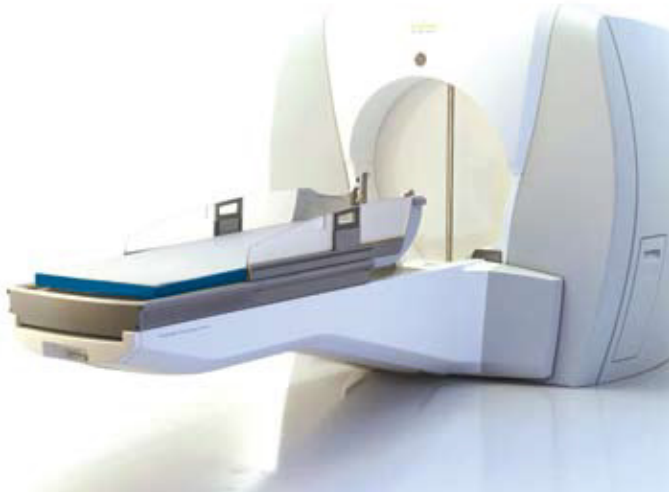

A GUIDE FOR REFERRING DOCTORS

GAMMA KNIFE

AT MACQUARIE UNIVERSITY HOSPITAL



Referrals 9812 3220

MACQUARIE UNIVERSITY
Hospital

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GAMMA KNIFE

Combined Expertise

Macquarie University Hospital owns Australia's only Gamma Knife. Gamma Knife Surgery has revolutionised the management of brain tumours and other brain conditions that may have previously required invasive surgery.

The hospital works with Macquarie Neurosurgery, a group of neurosurgeons that provide a comprehensive neurosurgical service across all subspecialties. They also work with Genesis Cancer Care, a national network of comprehensive cancer centres across Australia, to assist in the provision of Gamma Knife services.

The groups have combined their expertise in Neurosurgery and Radiation Oncology to provide a high quality, cost-effective radio surgical service for patients.

Multi-Disciplinary Team Approach

The Gamma Knife multi-disciplinary team (MDT) consists of Radiation Oncologists, Neurosurgeons, Medical physicists and specialised radiation therapists and nurses. The MDT hold regular meetings at which every case referred is discussed before treatment is approved. All possible treatment options are explored in this meeting to ensure that only patients who are suitable for treatment are accepted. Macquarie University Cancer Institute provides a comprehensive cancer service which has links into the Gamma Knife programme for suitable Oncology patients.

All potential Gamma Knife patients are reviewed by radiation oncologists / neurosurgeons to further assess and discuss treatment paradigms including Gamma Knife Surgery, surgery and radiotherapy.

TREATMENT

Gamma Knife treatment is minimally invasive and uses highly accurate delivery of radiation from 192 cobalt sources around the head to treat lesions within the skull.

These converge at the point of treatment, ensuring highly accurate delivery of a therapeutic dose to the lesion or target, while greatly reducing the dose delivered to the surrounding healthy brain tissue.

We treat patients with the following intracranial conditions:

Cerebral metastases

Acoustic Neuroma

Meningioma

Aterio-venous malformations (AVM's)

Trigeminal neuralgia

Pituitary tumours

Glioblastoma multiforme (GBM)

Glomus jugulare tumours

Other conditions that may be suitable for Gamma Knife are haemgioblastomas, PNET tumours, schwanommas, chordomas, craniopharyngioma and functional disorders such as Parkinsons

If you are unsure if your patient is a suitable candidate for Gamma Knife treatment please do not hesitate to contact us to discuss further.

ADVANTAGES

For suitable patients the Gamma Knife has distinct advantages over surgery and other stereotactic based irradiation devices (Linac-based SRS, Cyber-Knife). The advantages can be seen from a patients, management (therapeutic, economic and logistic) and physics viewpoints.

For the patient:

- Extremely well tolerated
- Minimal interference with quality of life
- Single day procedure, no general anaesthetic required
- Minimally invasive, less trauma, no long recovery period, avoids cranial surgery
- No/minimal alopecia
- Little systemic side-effects
- Option for retreatment's (repeat SRS , WBRT or surgery)
- Patients family can attend for much of the day
- Ability to start other treatment modalities (eg chemotherapy) very quickly.

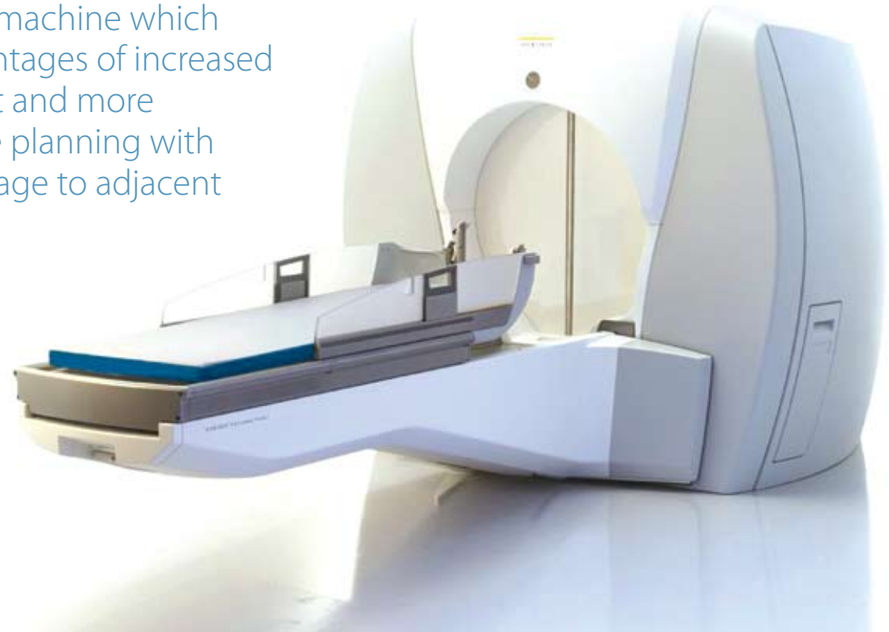
From a management viewpoint:

- Ability to treat lesions considered otherwise inoperable
- Ability to treat patients who have failed other treatment options including previous Linac based radiotherapy.
- Ability to treat >3 lesions simultaneously (up to 36 so far)
- Low risk of complications
- Economically cheaper than surgery, non-rebated at present
- No anaesthetic/post-op recovery costs
- Multiple (192) beams so less dose to normal brain tissue (0.52% dose per beam). This implies reduced morbidity, both short and long term
- Early eligibility onto trials requiring controlled cerebral metastases.

From a physics viewpoint:

- Fixed delivery geometry (fixed collimation system) gives unrivalled accuracy with no requirement for image guidance on treatment
- Fixed dose expectation (stable decay rate)
- Fixed energy spectrum means smaller penumbra and less scatter
- Smaller Virtual Source to Focus distance (503 mm average vs 1000 mm) reduces penumbral dose.

Macquarie University Hospital uses the state-of-the-art Perfexion Gamma Knife® machine which offers the advantages of increased patient comfort and more conformal dose planning with less risk of damage to adjacent eloquent areas.



EVIDENCE FOR EFFICACY OF GAMMA KNIFE TREATMENT AND CLINICAL APPLICATIONS

There is now a wealth of available literature confirming the efficacy of Gamma Knife treatment for a variety of intracranial pathologies. The concept of stereotactic biopsy first developed by Leksell and Larsson in Sweden in 1951, which progressed to the first Gamma Knife produced in 1968. Subsequent models B, C, 4 and 4C were developed, the latest version Perfexion was first introduced in 2006. This new integrated system with it's revolutionary design, provides full cranial coverage. The system is built to deliver outstanding patient comfort and better dosimetry performance than any other radio-surgical system. Over 500,000 patients worldwide have undergone Gamma Knife radio-surgery. The following conditions are the most commonly treated with Gamma Knife but this list is not exhaustive.

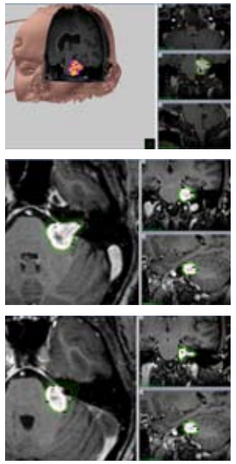
CONDITIONS COMMONLY TREATED WITH GAMMA KNIFE

Cerebral Metastases:

Around 15% of cancer patients will go on to develop cerebral metastases. Gamma Knife is very effective in the treatment of cerebral metastases; it is especially useful for multiple metastases where surgery is not an option. Gamma Knife can be used instead of whole brain radiotherapy (WBRT), in conjunction with it or after WBRT has failed to control the disease. For suitable patients the advantage of using Gamma Knife instead of WBRT is that the healthy brain tissue receives a minimal dose of radiation and therefore many of the devastating long term side effects associated with WBRT are avoided.

This is increasingly significant as chemotherapy drugs alter the natural history of certain cancers which result in their living longer despite the diagnosis of metastases. Patients can be treated again if new lesions appear. Many centres overseas especially in the USA and Japan are now no longer using WBRT in the treatment of cerebral metastases and are using Gamma Knife alone in the management of the disease. The aim of treating these patients with Gamma Knife is for them to live with a better quality of life and often this translates into improved survival as well.

Acoustic Neuroma:

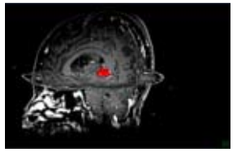


Gamma Knife is an excellent treatment in the management of acoustic neuromas (AN). Until relatively recently microsurgery was considered to be the standard treatment for AN, although many small tumours can be kept under observation and may never need to be treated. In the USA more AN's are treated with Gamma Knife now than with surgery and this trend is being seen worldwide. This has been due partially to patient pressure but also due to the increased experience of the treatment among referring clinicians. Tumour control with Gamma Knife has been reported to be about 97-97% for lesion <3cm. Patients who still have functional hearing on the affected side have a 70% chance of preserving their hearing but unlike surgery, the risk of facial weakness, facial twitching of facial numbness with current treatment doses (12-13Gy) is remote- less than 1%. When properly costed, Gamma Knife is cheaper than surgery, with most patients being treated as day cases and returning to work within a few days of treatment. There are almost no complications of treatment but a risk of malignant change is often quoted as a deterrent. Current data suggest that this risk is at most 1:1000 but may be as low as 1:10000 and is certainly less than the risk of a significant surgical complication. Only in patients with NF2 is the risk of malignant change higher than this. One recent review specifically looking at patients treated by the Gamma Knife reported no increased incidence.

Meningioma:

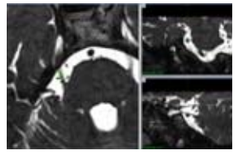
Radio-surgery may be indicated when there is an intention to treat and surgical resection is either incomplete or not possible without inflicting significant deficits (cavernous sinus tumours in particular but also parasagittal remnants and cerebello-pontine angle tumours). The use of radio-surgery as the primary treatment of smaller meningiomas, and it's use in combination with surgical decompression or subtotal removal (with avoidance of neurologic deficits that could arise from more radical removal) in the treatment of larger tumours, is emerging as the standard of care worldwide. Control is in the region of >90% or more for tumours with typical histology but is worse for WHO Grades 2 where the control is approximately 70% and even worse for WHO Grade 3 tumours which are considered by definition to be malignant, although even then radio-surgery may be worthwhile for palliation.

Aterio-Venous Malformation (AVM):



The aim of Gamma Knife treatment for AVM is total obliteration of the abnormal collection of blood vessels to reduce the chance of spontaneous haemorrhage. There is a risk of 2% to 4% of AVM's bleeding spontaneously each year. The risk of haemorrhage may increase with age. Radio-surgery causes proliferation of the blood vessel lining, gradually occluding the AVM over time. Approximately 80% of AVM's under 3 cm in diameter will occlude by 2 years after treatment and 90% three years following radio-surgery. During this time there is no increased risk of haemorrhage, although a risk is still present. Radio-surgery is sometimes the only curative treatment available in high-risk AVM's. An example is an AVM in the brain stem, basal ganglia or eloquent brain, which bring a high risk of neurological deficit following surgery. In the case of large AVM's that are unsuitable for surgery Gamma Knife can be used in 2 stages, with the doses separated by 6 months. This allows treatment of lesions previously considered too large for Gamma Knife.

Trigeminal Neuralgia:



There is now significant literature regarding the efficacy of Gamma Knife radio-surgery in the treatment of Trigeminal Neuralgia. Although not as effective as microvascular decompression there is a cohort of patients unfit for or unwilling to consider surgery for whom nerve injury and facial numbness using percutaneous treatments can be avoided. As many patients who suffer from this condition are elderly who may be a high anaesthetic risk it is useful to have an alternative for these types of patients. Current figures suggest a three year efficacy of approximately 70% for Gamma Knife treatment with a 15% facial dysaesthesia risk. Retreatment using a complementary protocol is possible if treatment is unsuccessful or pain returns after a period of time.

Pituitary Adenoma:

Gamma Knife treatment is generally used after incomplete tumour resection or tumour persistence or recurrence. As opposed to external beam radiotherapy, Gamma Knife achieves tumour control but has the advantage of being a day case treatment as well achieving more rapid falls in hormone levels than after conventional radiotherapy. Potential drawbacks of Linac-based radiotherapy are the greater risk of side effects; including hypopituitarism, optic neuritis, cognitive dysfunction and possibly a greater risk of radiation induced cerebral tumours. These latter side effects occur at a mean time of 10-20 years but have not been associated with the use of Gamma Knife.

Glioblastoma multiforme (GBM):

These tumours tend to infiltrate the brain beyond the edge visible on a CT/MR scan and therefore, are rarely suitable for primary Gamma Knife treatment. Conventional radiotherapy is normally used but Gamma Knife may be of benefit in some circumstances as a boost to conventional radiotherapy or as primary treatment for recurrence. Patients and families are advised prior to treatment for recurrence that cure is not an expected result and treatment is aimed at prolonging quantity and quality of life.

Glomus jugulare tumours:

Glomus jugulare tumours are rare tumours that commonly involve the middle ear, temporal bone, and lower cranial nerves. Resection, embolization, and radiation therapy have been the mainstays of treatment. Despite these therapies, tumour control can be difficult to achieve particularly without undue risk of patient morbidity or mortality. Gamma Knife surgery has been shown to afford effective local tumour control and preserves neurological function in patients with glomus jugulare tumours.

REFERRAL PROCESS

Referrals can be made to the MDT.
To make a referral to the MDT please call 9812 3220.
Alternatively you can refer to one of the treating team:

Dr. John Fuller
Neurosurgery
Suite 201 2 Technology Place
Macquarie University
NSW 2019.
Tel: 1300 622 782

Dr. Michael Izard
Radiation Oncology
Level B2 3 Technology Place
Macquarie University
NSW 2019.
Tel: (02) 9812 3220

Dr. Annie Ho
Radiation Oncology
Level B2 3 Technology Place
Macquarie University
NSW 2019.
Tel: (02) 9812 3220

FURTHER READING

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