How do I do it: advantages, limitations and pitfalls of intra-op MRI.
BELGRANO ADVENTIST CLINIC

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HOW DO I DO IT?

LOW GRADE GLIOMAS

INSULAR TUMORS

HIGH GRADE GLIOMAS

iMRI in “ELOQUENT BRAIN AREAS”

iMRI

CONCLUSIONS
It has always been worrying to a neurosurgeon to know exactly **where he is working in the brain.**

- Where the **pathology** is …
- Where a **tumor begins or ends**…
- Where the **most important functional areas** are…
- How much of the **tumors has been removed** and the **most important**, **how much has been left behind** for not having seen it.
Philiphs Medical System. Vertical field 0.23 T.

C-shapened “open” magnet.
BELGRANO
ADVENTIST CLINIC

OPERATING ROOM
BELGRANO ADVENTIST CLINIC

OPERATING ROOM
Titanium and Aluminum head rest.
How do I do it?

Many brain tumors, particularly low-grade gliomas, have the look and feel of normal brain. Without iMRI, achieving gross total resection without being unduly aggressive with the normal tissue is virtually impossible. With iMRI, however, the neurosurgeon can evaluate the brain at any time during resection, and thus, he can both avoid eloquent structures damage and achieve a more complete resection.
Fem. 78 (r)

Temporo-Occip. GBM.
This is the patient in surgical position.
We operate the tumor conventionally and make anatomical and morphological removing.
Then, when de things seem to be the same but are not, we put some marks on the surgical bed and check it with a new Intraoperative MRI.
Intraoperative control

We are checking the surgical steps with new images.
Then we go on with the surgery.
We can see the marks on the surgical bed with complete removal of the tumor and the patient with very good outcomes.
LOW GRADE GLIOMAS
iMRI “ADVANTAGE”

iMRI gives us the possibility to monitor tumor location, follow its extension to deeper areas and be sure to have reached its limits. It allows us to leave the operating room knowing we have removed the entire tumor, achieving the surgical target we set, preserving normal tissue and having not big surprises at first MRI postsurgical control.
● **Extraventricular Neurocitoma**

9 year old boy.

**July 2000**
11 years

Post-Operative.
LOW GRADE GLIOMAS

- Fem. 25

2005
Post-Operative

2010
Fem. 2 Years Old.
OLIGODENDROGLIOMA.

Operated in another Country.

August 2004
- MRI six months after the first operation.

Partial resection.
- **MRI** six months after the first operation.

  Partial resection.
LOW GRADE GLIOMAS

- iMRI Surgery.

February 2005
Here is the post operative MRI control with complete removal of the tumor.
Here is the same in sagital plane.

Pre-operative above and post operative below.
LOW GRADE GLIOMAS

- **A:** 10 days post-operative.
- **B:** 1 month post-operative.
- **C:** 1 month post-operative.
LOW GRADE GLIOMAS

- Three years after surgery.

2008
Six years after surgery.

Summer 2011
LOW GRADE GLIOMAS

- MRI. 7 Years.

Post-Operative.
LOW GRADE GLIOMAS

- PH. M. 54
  Frontal left.
  Oligodendroglioma.
LOW GRADE GLIOMAS

• LGG
A residual tumor was found in iMRI so that resection had to be expanded.
Complete removal.
Complete removal.
LOW GRADE GLIOMAS

- Post-Operative MRI.
Five Years Post-Operative.
LOW GRADE GLIOMAS

- Fem. 17
  Pre motor area.
  Right LGG.
A: The operating field. Can I be completely sure where the tumor is?

B: Intraoperative MRI.
LOW GRADE GLIOMAS

- Post-Operative MRI control with complete removal of the tumor.
LOW GRADE GLIOMAS

- Post-Operative patient outcome.
LOW GRADE GLIOMAS

- LGG. M. 32.
  Pre Central Left.
LOW GRADE GLIOMAS

- Anatomical and Morphological resection.
Post-Operative MRI control with complete removal of the tumor and the patient in excellent outcome without neurological deficit.
LOW GRADE GLIOMAS

- M. 13

Oligodendroglioma.
LOW GRADE GLIOMAS
LOW GRADE GLIOMAS

- Intraoperative MRI and Post-Operative patient outcome.
INSULAR TUMORS

21 CASES OPERATED

- 15 with iMRI.
- 1 with Neuronavigator.
- 5 Conventional neurosurgery.
- 17 L.G.G.
- 4 H.G.G.
MRI offers several palpable advantages. Most important among these are improved medical outcomes, shorter hospitalization, and better and faster procedures with fewer complications.

Specifically, in the context of the real-time representation of the patient's anatomy, we have improved the quality and utility of the information presented to the surgeon, which, in turn, contributes to more successful surgical outcomes.
This is a typical Insular Glioma. In Gliomas of Insular Region, the **iMRI** is very useful.
We can see the Silvian fissure opened showing the tumor on the left, and the tumor removed on the right.
This is the middle cerebral artery preserved.
INSULAR TUMORS

- Post-Operative Control.
LGG. F. 28.
Left Insular.
LGG, should not just be watched because they are growing while we are watching them.
February 2008
1 month Post-Operative.
3 years Post-Operative.
Fem. 22 Years Old.

Oligodendroglioma.
Decompressive Craniectomy in her city.

April 2005
Intraoperative MRI surgery.

May 2005
INSULAR TUMORS

- July 2010
This is another typical Insular Glioma in a little boy.
3 years old boy. LGG

Intraoperative MRI.
M. 3 LGG.

Intraoperative imaging.
Complete tumor removal.
HIGH GRADE GLIOMAS
iMRI “ADVANTAGE”

iMRI completes the possibility of neurosurgeons to see beyond even what can be seen through the microscope. This is an important issue, principally on brain glioma surgeries, where the physician wants to achieve GTR. Greater tumoral cytoreduction is always a favorable factor in quality and quantity of survival, even in trials evaluating chemotherapy and/or radiotherapy schedules.

Survival of patients is correlated to the extension of tumoral resection.
M. 82 years old.
G.B.M.

HIGH GRADE GLIOMAS
Here we are doing Neurophysiological Monitoring.

Locating the motor area and placing a finger glove with air before the iMRI control.

June 2008
Above we can see **iMRI** checking at the beginning of the surgery and below, final **iMRI** control with **GTRs** of the tumor.
The same in coronal series.
The same in axial series with GTRs.
M. 82 years old.
G.B.M.

21 months
Post-Operative.
This is the case of a woman. She had this tumor in 2007. It was an Oligodendroglioma.
2008 Anaplastic ODG.

One year later, the tumor enhanced with paramagnetic contrast and turned into a HGG.
HIGH GRADE GLIOMAS

FEBRUARY 2008
We operated her awake and we localized the motor area with intraoperative Evoked Potentials.
This is the surgical bed after tumor resection with the brain stem completely free after fronto-basal and temporal lobe removal.
The post operative MRI control 28 month after surgery.

June 2010
Anaplastic Oligodendroastrocytoma.

February 2008
October 2008

MRI Post-Operative.
October 2008

Post-Operative.
June 2010

Complete tumor removal.
June 2010

Complete tumor removal.
HIGH GRADE GLIOMAS

- FEM. 32.
  Mixed Glioma.
  Anaplastic Oligodendroastrocytoma.

GTR Surgery
- + RTP
- + TMZ

Three years after surgery.
A teenager girl with remaining tumor after having been operated with stereotactic guidance.
Here an **iMRI** control with tumor remnant and below after complete tumor resection.
M. 39. G.B.M.

When we removed completely a brain glioma, in most of the cases, the surgical cavity has the same shape of the tumor removed.
HIGH GRADE GLIOMAS

- Corpus Callosum HGG.
We operated it through Inter hemispherical approach.
THIS IS THE PATIENT IN POST-OPERATIVE HIGH GRADE Gliomas
INTRAOPERATIVE iMRI “ADVANTAGES”

Neurophysiological Monitoring and Neuronavigation in “eloquent brain areas”

(One of the advantages of low field intraoperative systems, is that all kind of intraoperative neuromonitoring can be practiced very easily).
M. 27.

Glioma located in the left primary motor cortex.
High field functional MRI, spectroscopy and tractography.
iMRI in “ELOQUENT BRAIN AREAS”
iMRI in “ELOQUENT BRAIN AREAS”
iMRI in "ELOQUENT BRAIN AREAS"
Intraoperative Electrophysiology. Cortical stimulation and somatosensory evoked potentials.
iMRI in “ELOQUENT BRAIN AREAS”

INTRAOPERATIVE MRI
iMRI in “ELOQUENT BRAIN AREAS”
iMRI in “ELOQUENT BRAIN AREAS”
iMRI in “ELOQUENT BRAIN AREAS”

INTRAOPERATIVE MRI, POST. TUMOR RESECTION
The patient after surgery.
No neurological deficit.
M. 30 Years Old.

Multicentric Oligodendroglioma.

This patient had two tumors. One in right temporal lobe and the other in left parietal lobe near motor area.
First we operated temporal tumor and resected it completely.

July 2006
Cortical Electrical Stimulation.

Two months later, we operated his parietal tumor using intraoperative MRI and cortical stimulation.
PRE-OPERATIVE.
POST-OPERATIVE.
iMRI in "ELOQUENT BRAIN AREAS"

FIVE YEARS POST-OPERATIVE
M. 32.

Wernicke area LGG.
We operated the patient awake and removed the tumor completely.
iMRI in "ELOQUENT BRAIN AREAS"
A TEENAGERS GIRL WITH THIS RIGHT PRE CENTRAL LGG GLIOMA
She had a tumor which pushed the cortico spinal tract.
We operated her with sub cortical electrical stimulation to preserve the cortico spinal tract.
We operated her with subcortical electrical stimulation to preserve the cortico spinal tract.
We can see Sub Cortical Electrical Stimulation to preserve the cortico spinal tract.
iMRI in “ELOQUENT BRAIN AREAS”
And this is the patient right after the operation and completely recovered a few months later.
Neuronavigation

We started working adding the neuronavigation to iMRI in the last two years.

We use it mainly to guide the surgical approach and locate eloquent areas in the early stages of the operation.
COST

Certain economic and practical barriers also impede the large-scale use of intraoperative MRI. Clearly, performing iMRI for brain tumor resection increases costs, both for the equipment and site and for physician time. For high-grade malignant gliomas the additional cost may not be warranted, although perioperative morbidity rates would be expected to decrease with better intraoperative visualization.

“However, for low-grade gliomas, which are potentially curable with complete tumor removal, the use of IMRI, I believe that the cost is justified”.

(Arguing against the clinical benefits of Intraoperative MRI is very difficult).
Surgical Patient Position

With our system, we can not operate patients in sitting position. Companies that manufacture magnetic resonance equipment that are used to operate, should in the future design operating tables that allow better patients positioning during surgery.

We modify the original operating table to operate in all surgical positions except in sitting position.
Infections Incidence
The infections range is the same as in conventional neurosurgery.

Brain Shift
The brain shift during surgery is not a problem because the anatomical landmarks are taken from new MR imaging obtained while the surgery is performed.

Special instruments
The surgical microscope, microsurgical tools and conventional neurosurgery instruments, can be used throughout the operation because the magnet is turned on only for intraoperative controls. During the rest of the time, the magnetic field is off.
In all brain gliomas operations a GROSS TOTAL RESECTION should be attempted and intraoperative MRI is very useful for this.

This is why we believe that all Brain Gliomas should be operated with Intraoperative M.R.I.
We think the brain gliomas surgery, reached its Highest point with the **iMRI**.

We should work on how to detect gliomas earlier than we are doing now and so, we will be able to cure a lot of them.

**THANK YOU!**

*PresentationPoint*

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