

Altogether
to Beat
Cushing's
Syndrome



Viaggio alla (ri)scoperta della sindrome di Cushing

Il ruolo della moderna Risonanza Magnetica

Fabio Tortora

Seconda Università degli Studi di Napoli

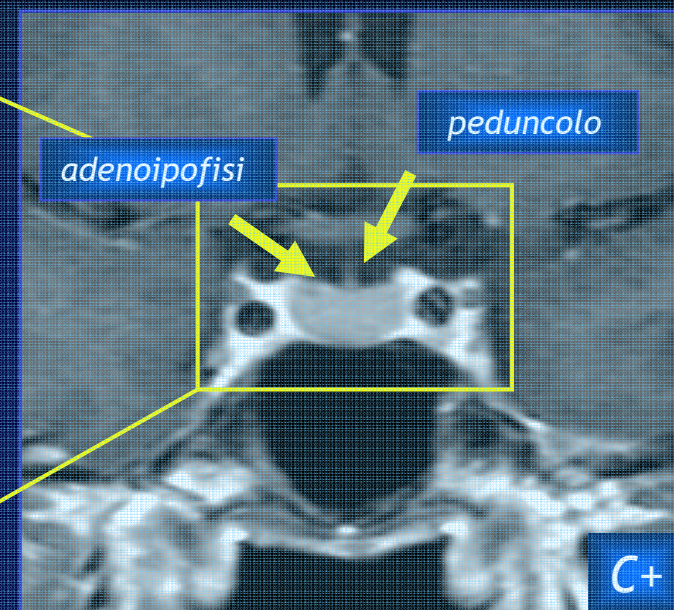
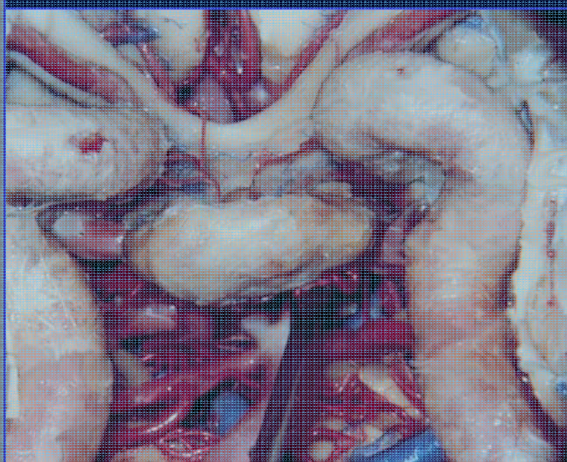
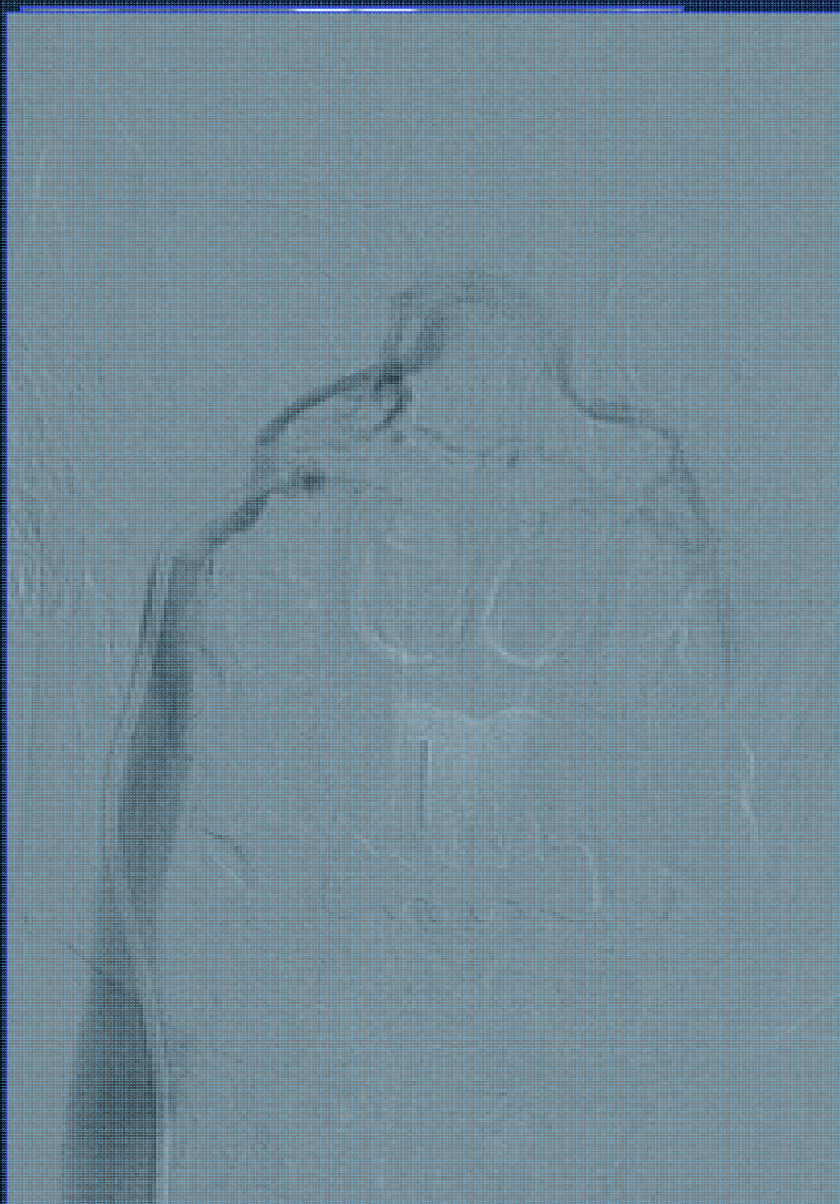
Dipartimento di Scienze Neurologiche



Capri , 16 Maggio 2013



REGIONE SELLARE



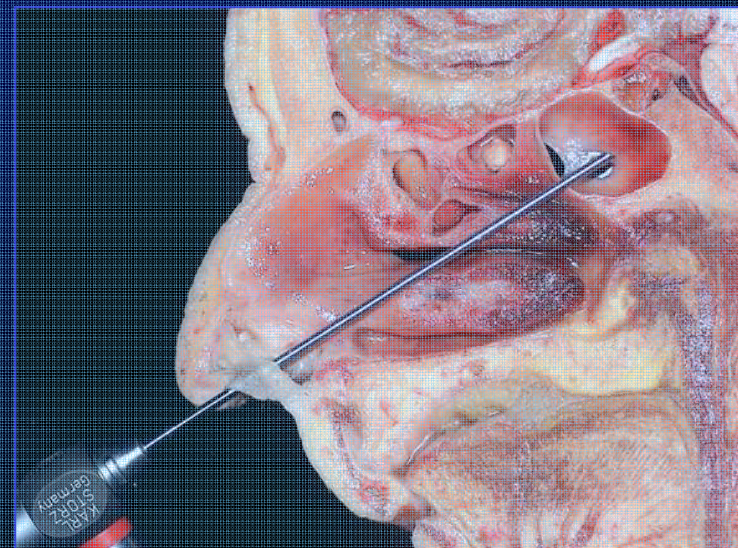
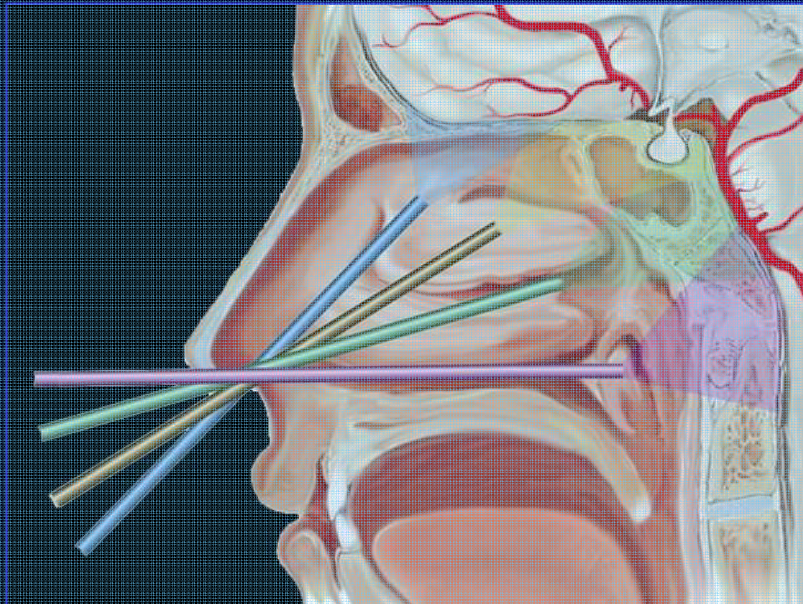
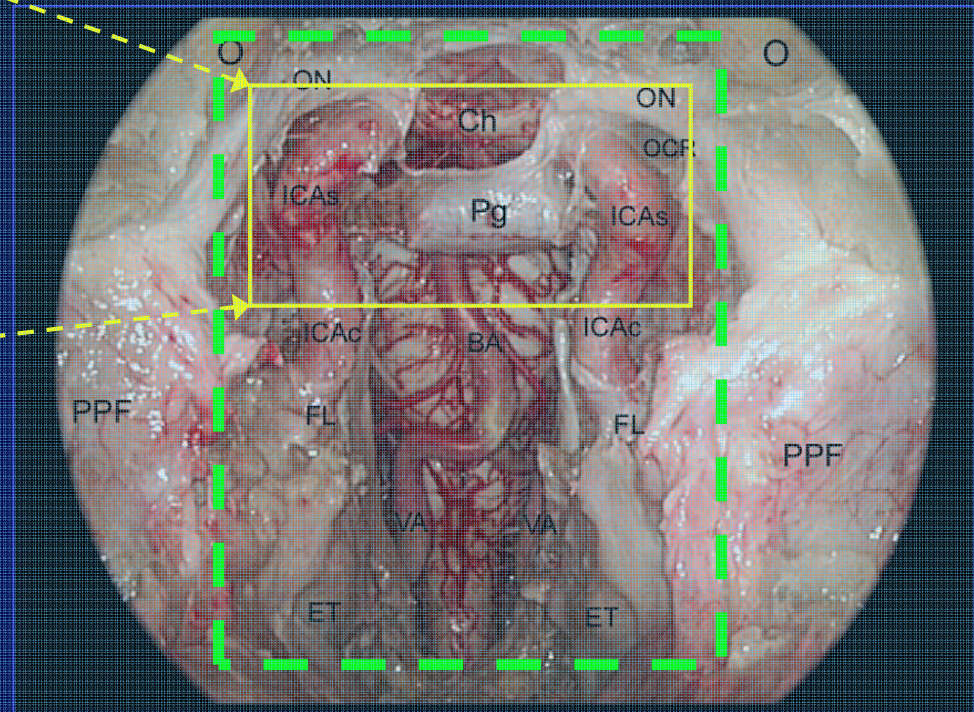
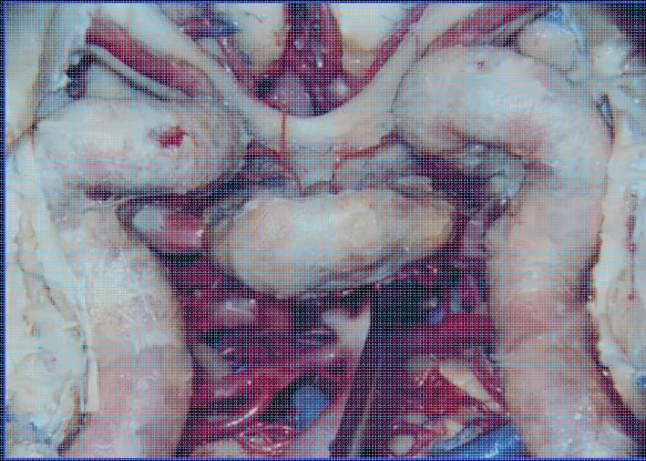
la **Risonanza Magnetica** riassume tutte le indicazioni per lo studio morfologico della regione sellare ...

la **Tomografia Computerizzata** deve essere riservata in seconda istanza a casi selezionati ...”

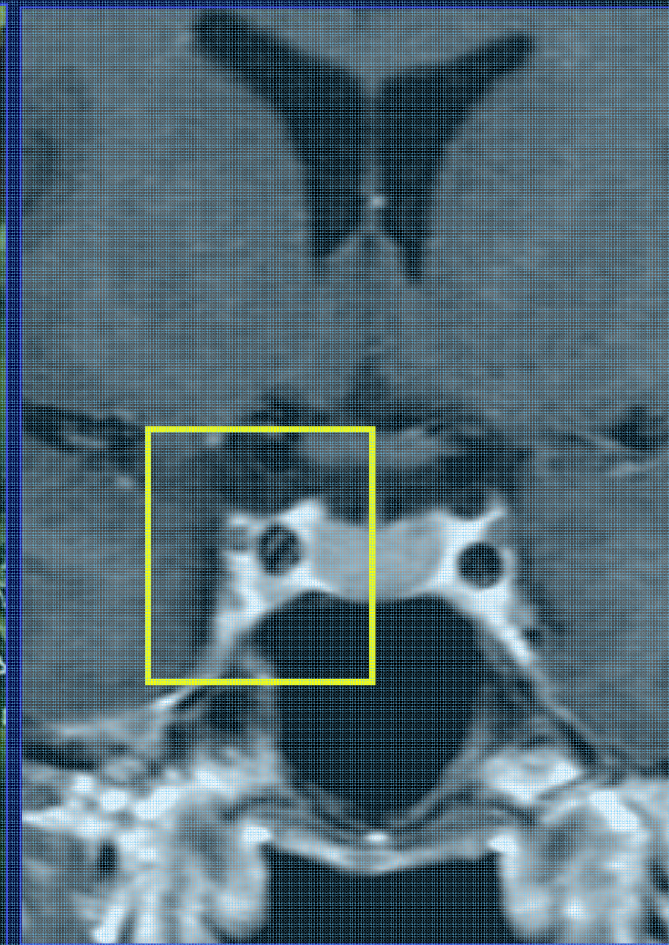
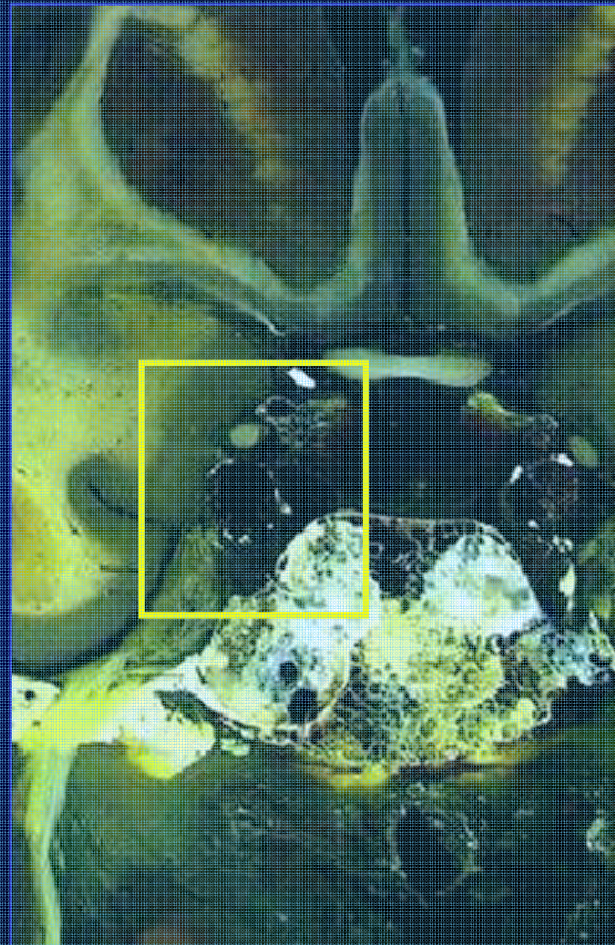
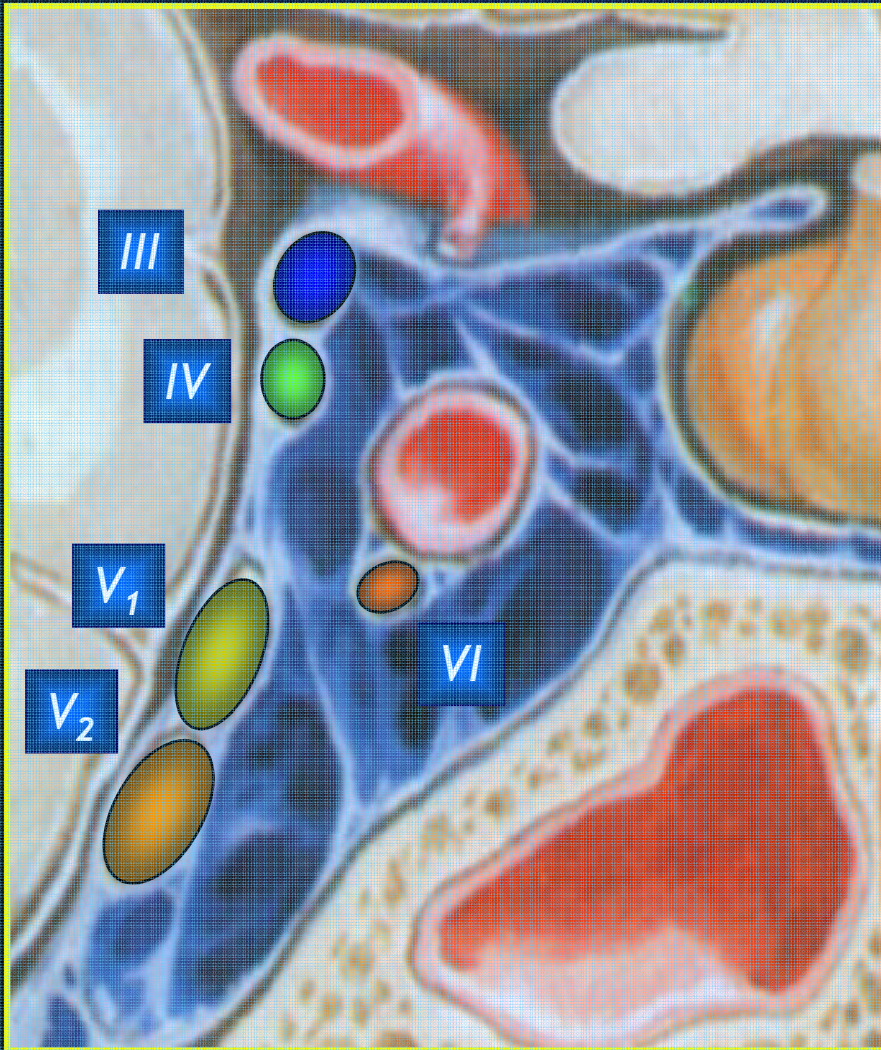
Bonneville JF et Al: *Magnetic Resonance Imaging of the pituitary area.*

Riv Neuroradiol 13 (Suppl 1): 91-100, 2000.

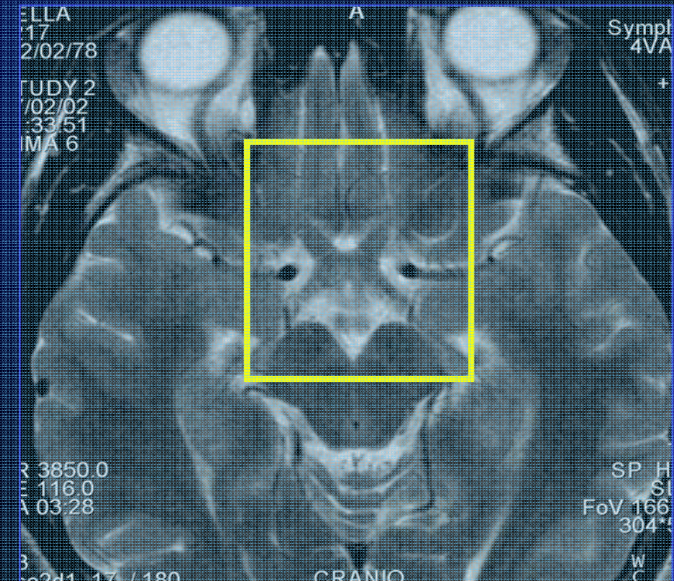
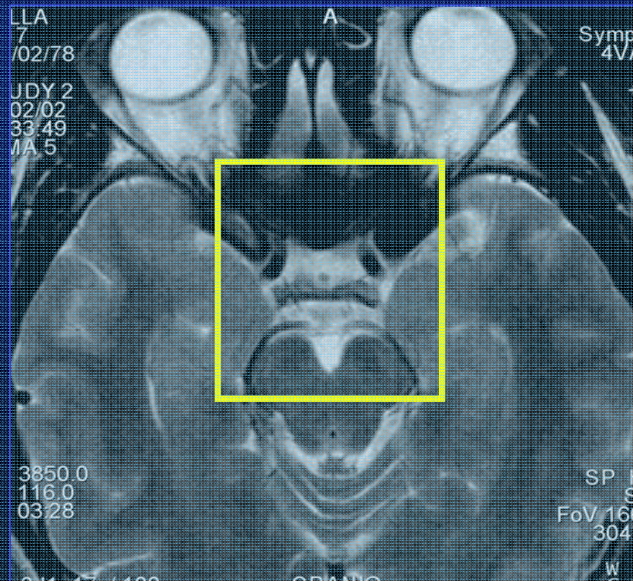
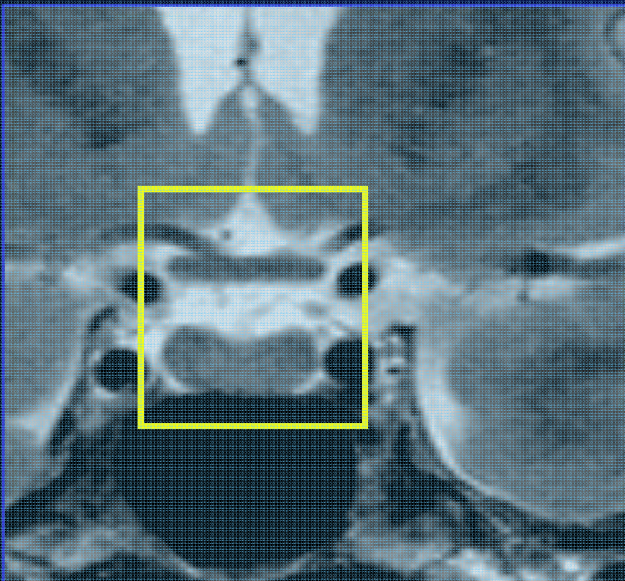
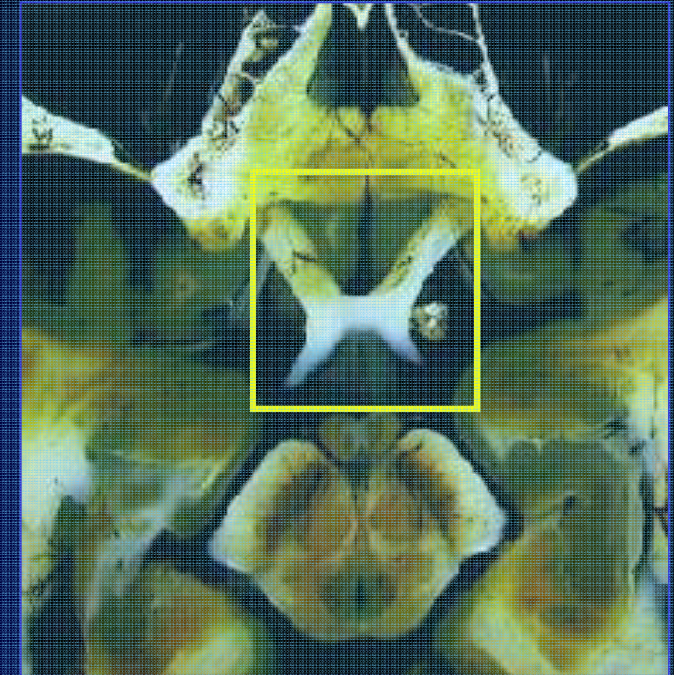
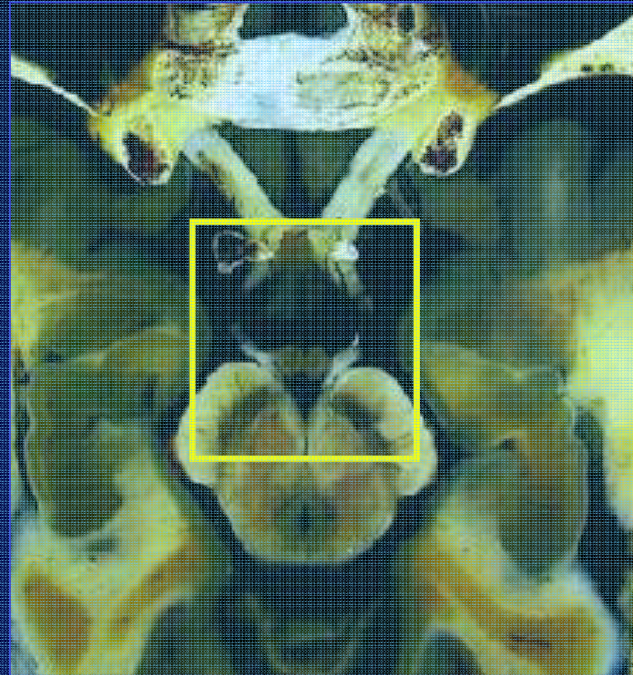
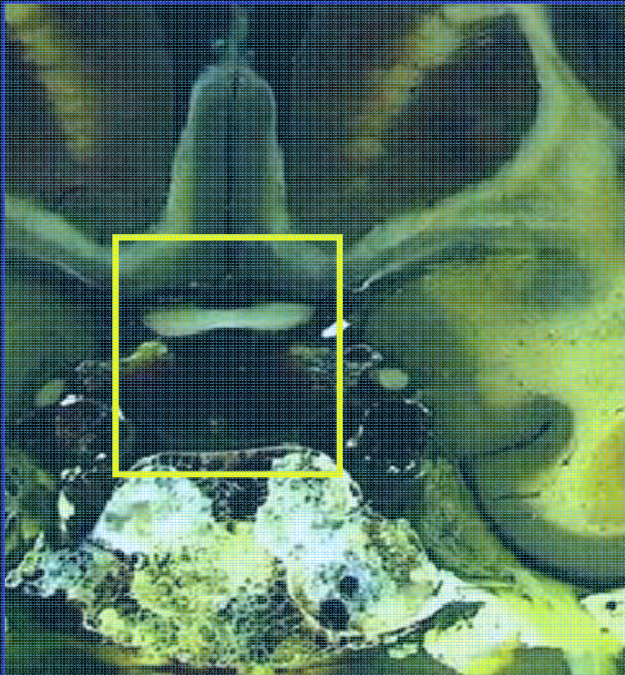
ANATOMIA NEURORADIOLOGICA



ANATOMIA NEURORADIOLOGICA

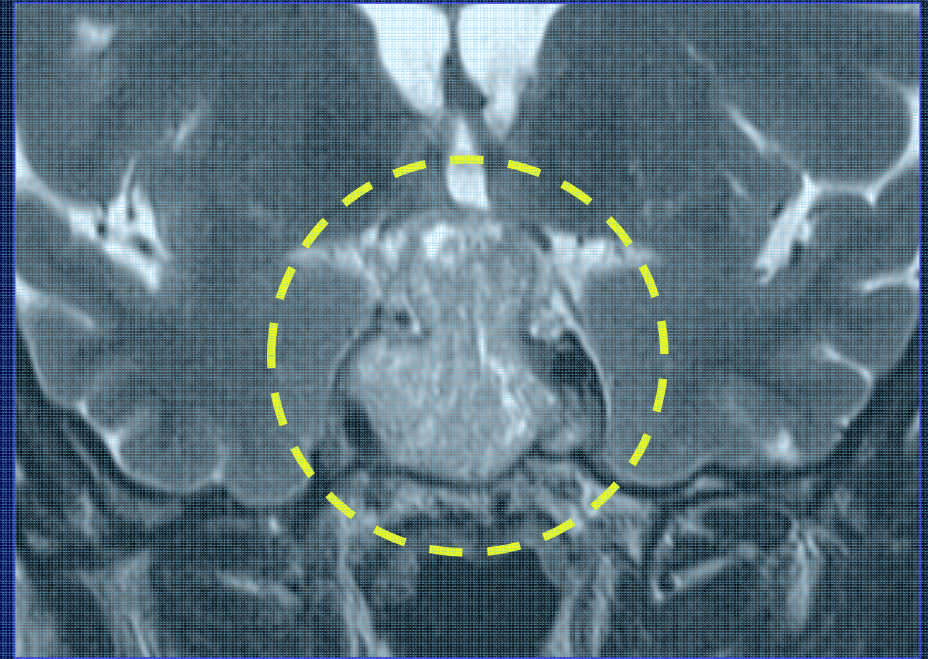
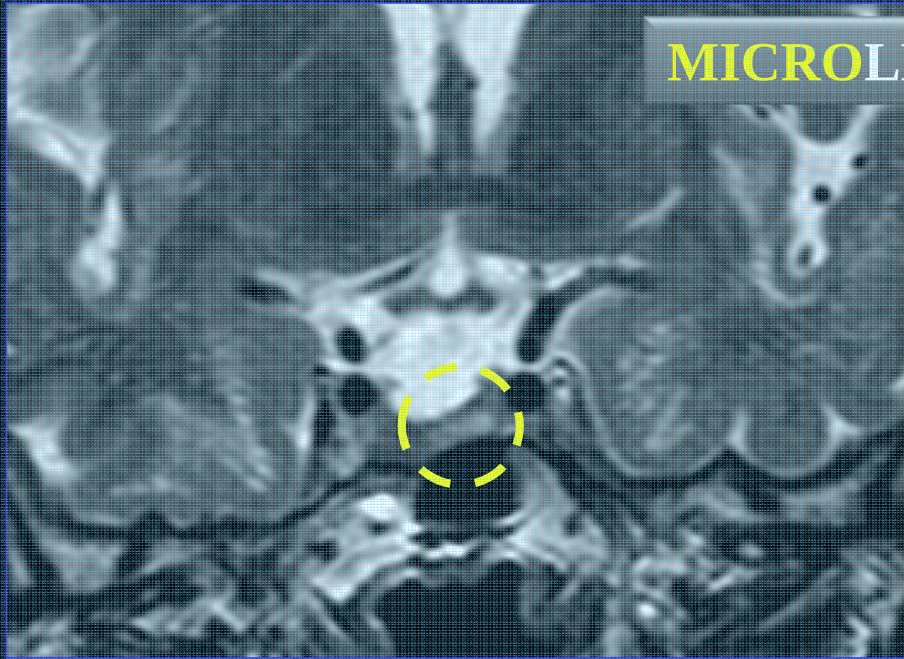


ANATOMIA NEURORADIOLOGICA

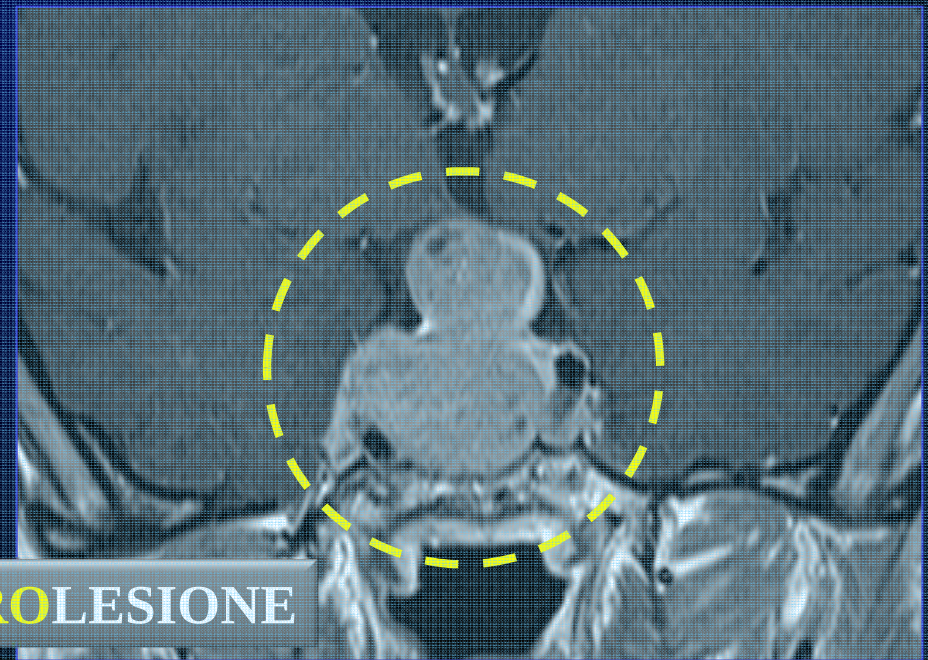
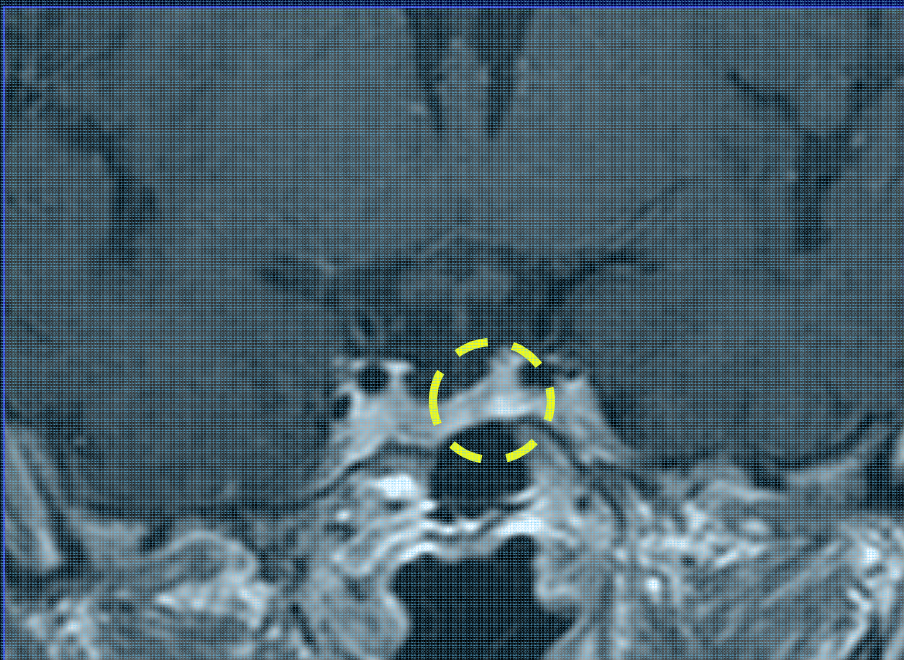


STUDIO NEURORADIOLOGICO

MICROLESIONE

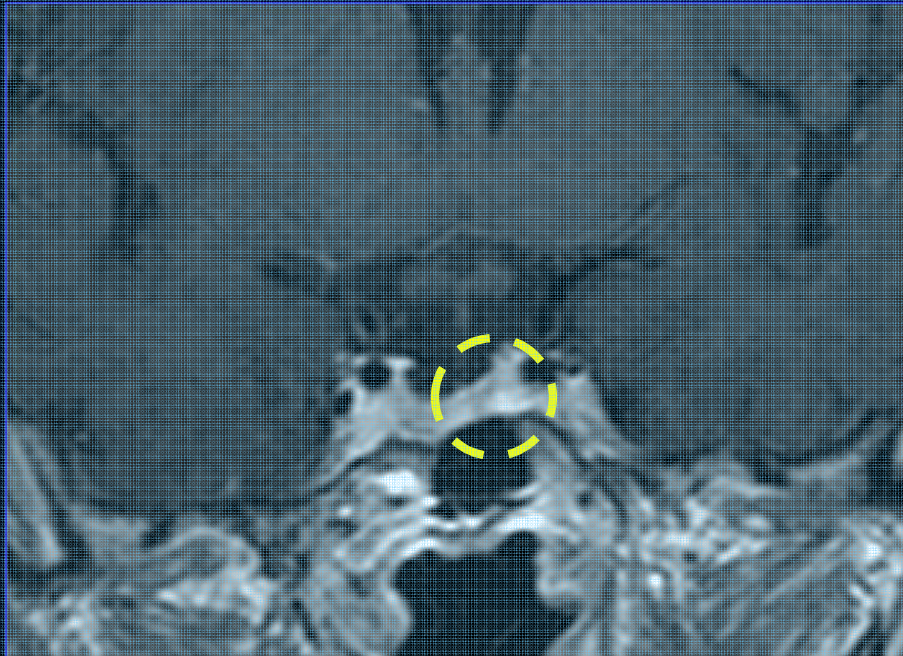


MACROLESIONE

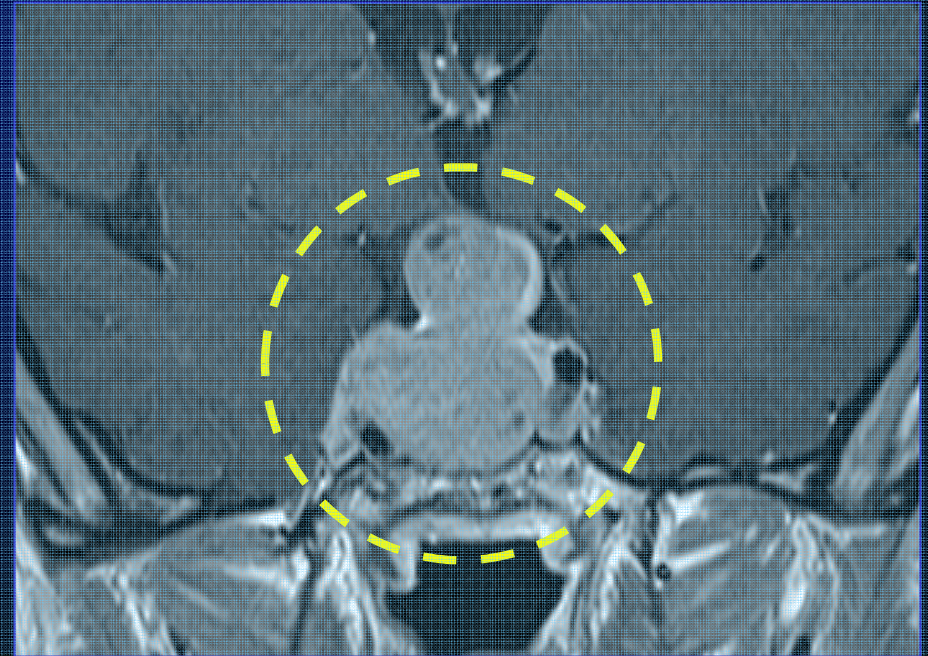


STUDIO NEURORADIOLOGICO

- ✓ strato sottile (1-3 mm)
- ✓ piano sagittale (logge cavernose)
- ✓ piano coronale (peduncolo ipofisario)
- ✓ piano assiale (pavimento sellare)



- ✓ strato sottile (2-3 mm)
- ✓ piano sagittale (margin lateral della lesione)
- ✓ piano coronale (margine ant. - post. della lesione)
- ✓ piano assiale (margine caudale - craniale della lesione)



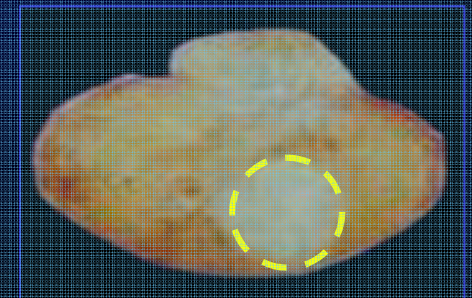
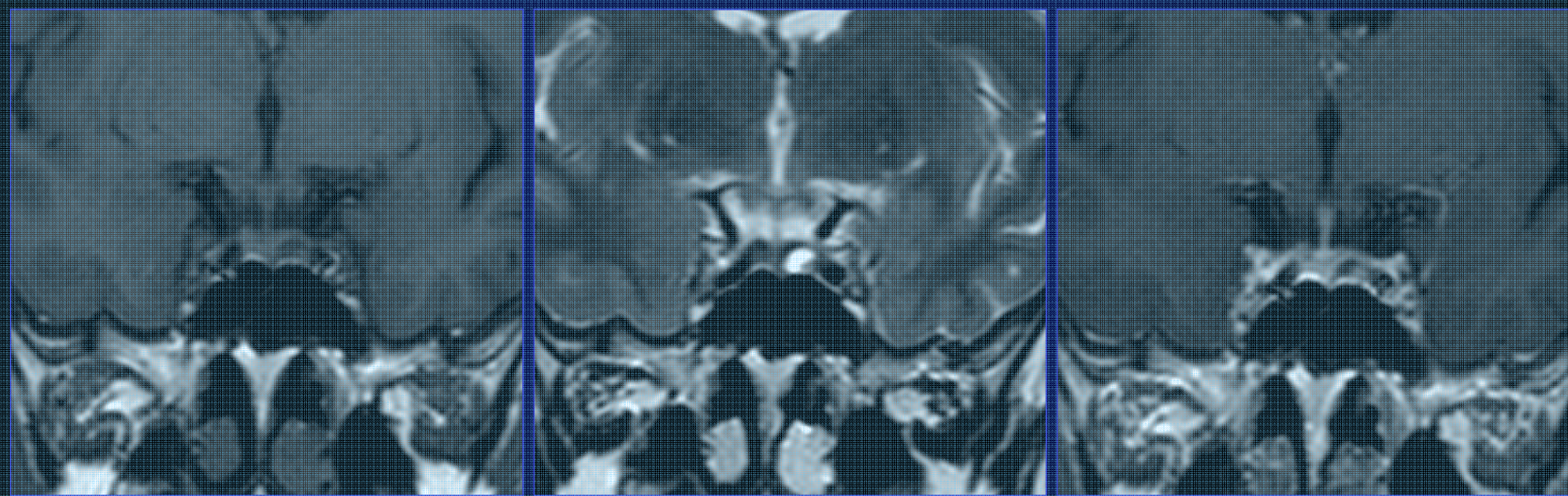
MICROADENOMA IPOFISARIO

SEGNI DIRETTI

lesione intraghiandolare < 10 mm

✓ **area focale di alterato segnale**

✓ **area focale di alterata impregnazione**



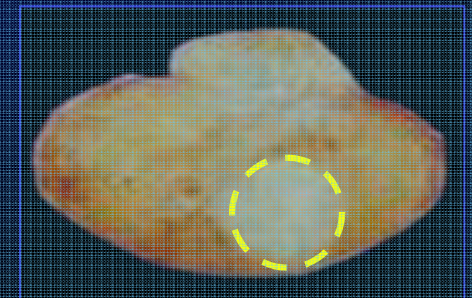
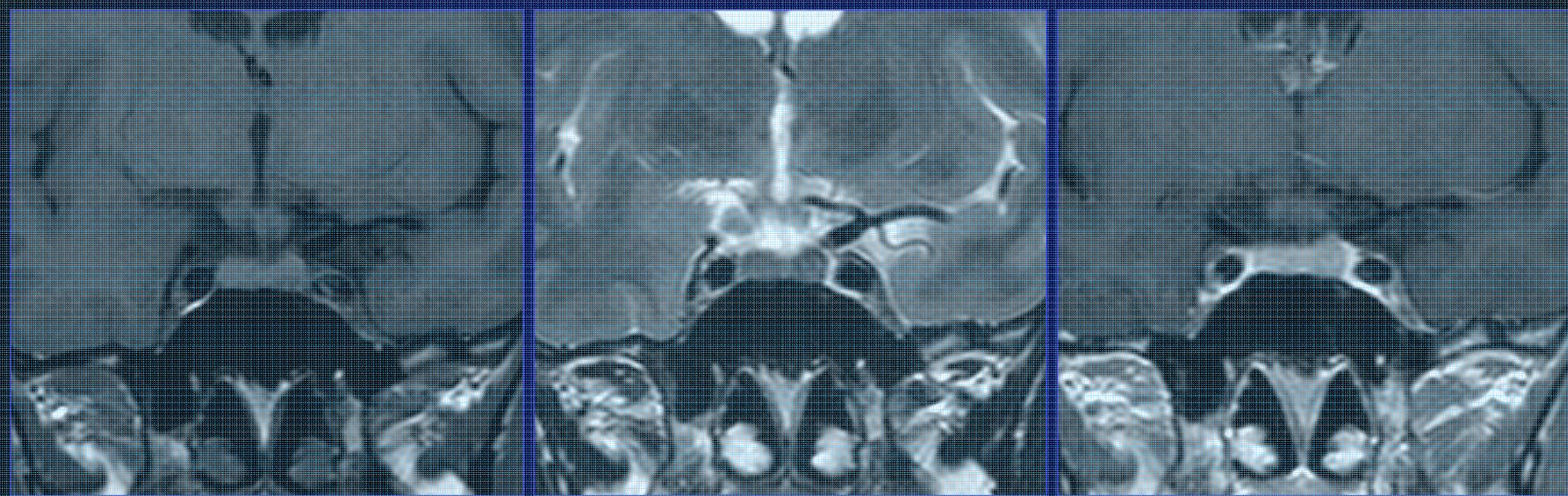
MICROADENOMA IPOFISARIO

SEGNI DIRETTI

lesione intraghiandolare < 10 mm

✓ **area focale di alterato segnale**

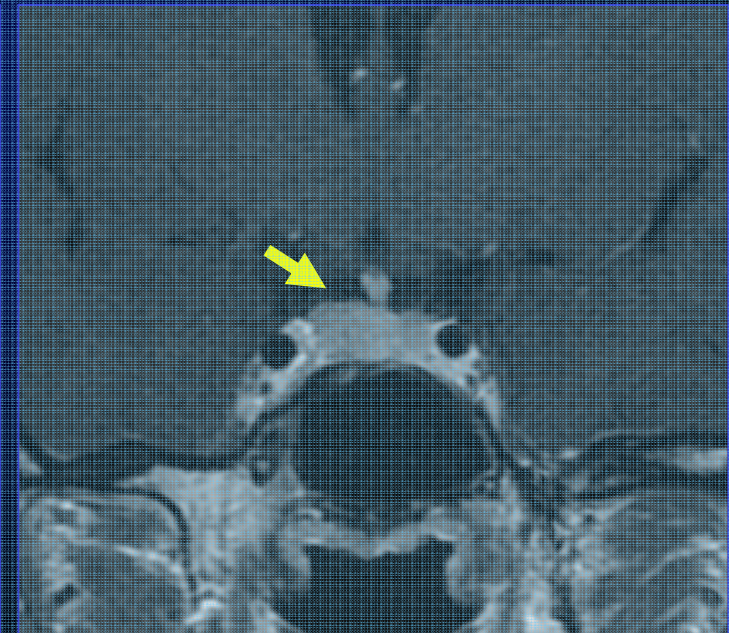
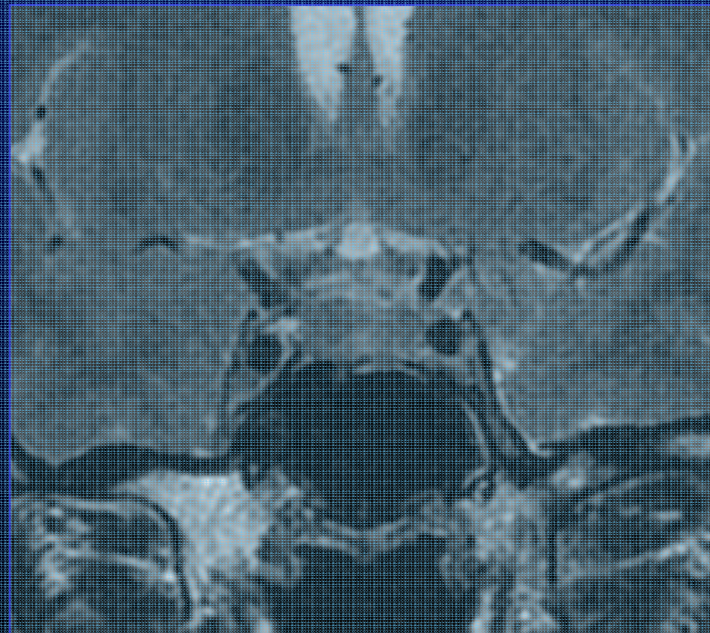
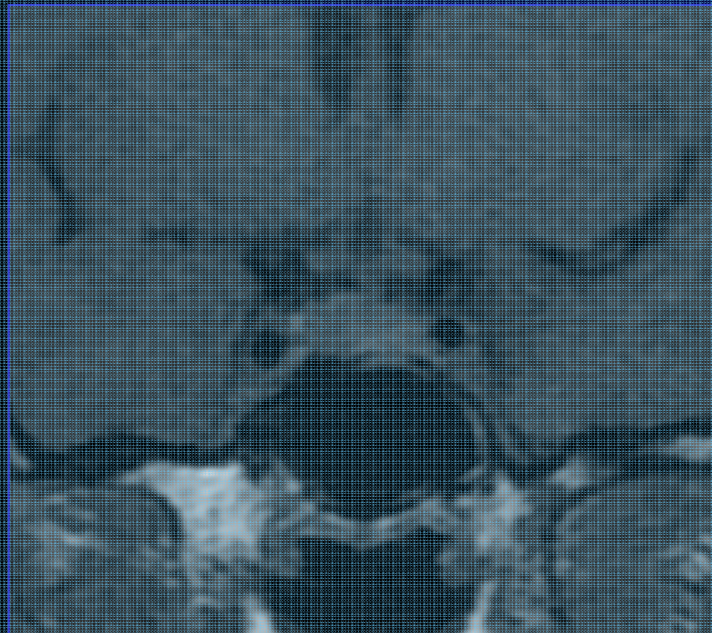
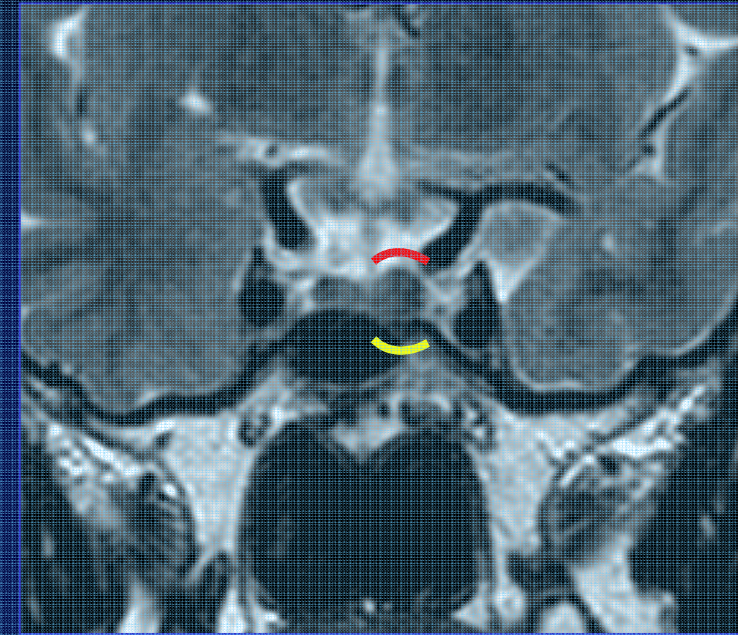
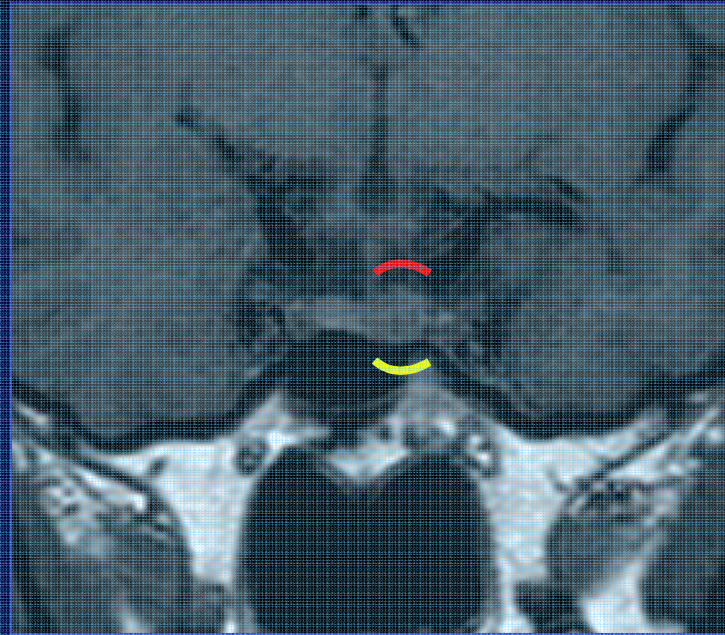
✓ **area focale di alterata impregnazione**



MICROADENOMA IPOFISARIO

SEGNI INDIRETTI

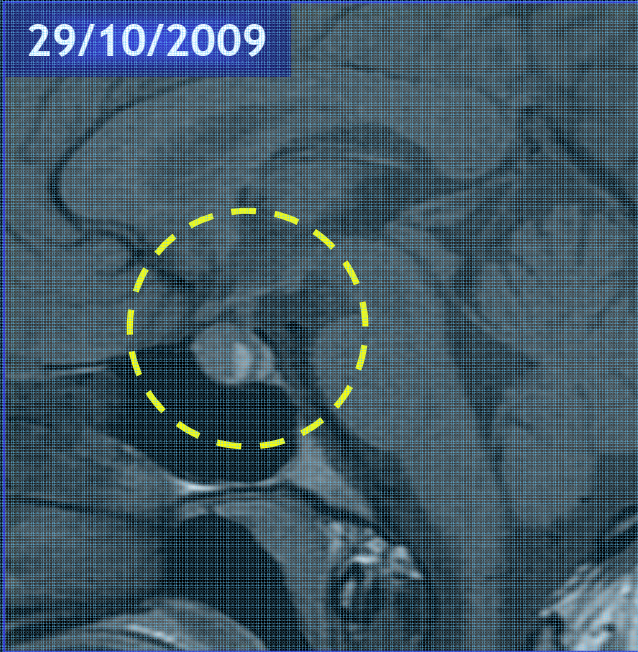
- ✓ convessità superiore
- ✓ erosione pavimento
- ➔ deviazione peduncolo



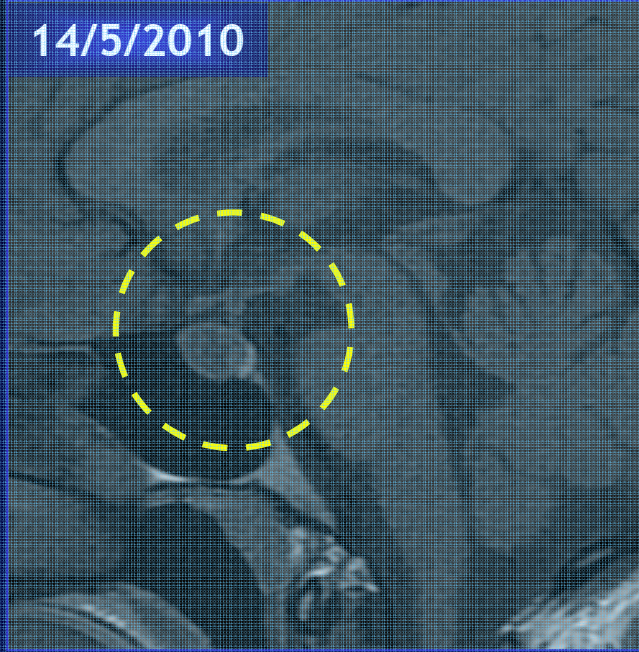
T₁

MICROADENOMA IPOFISARIO

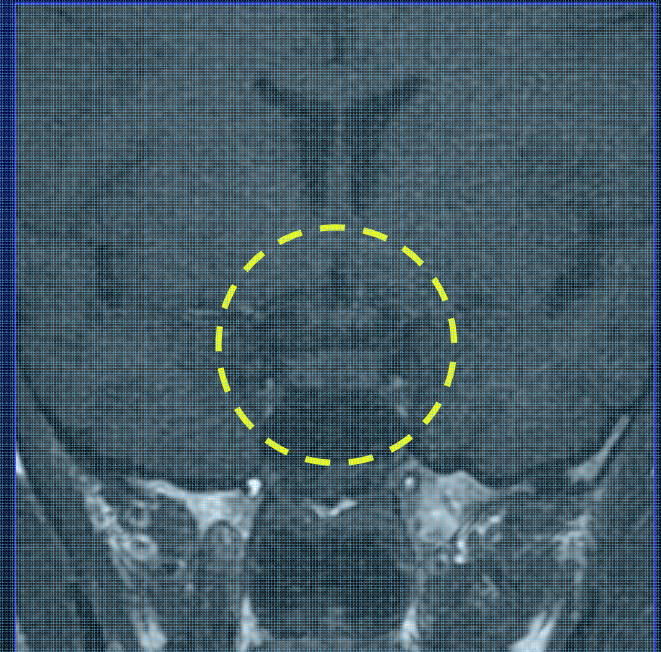
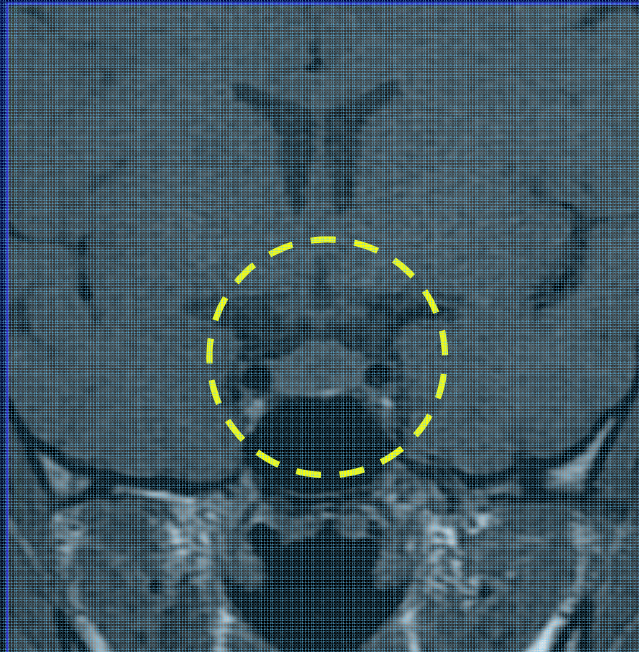
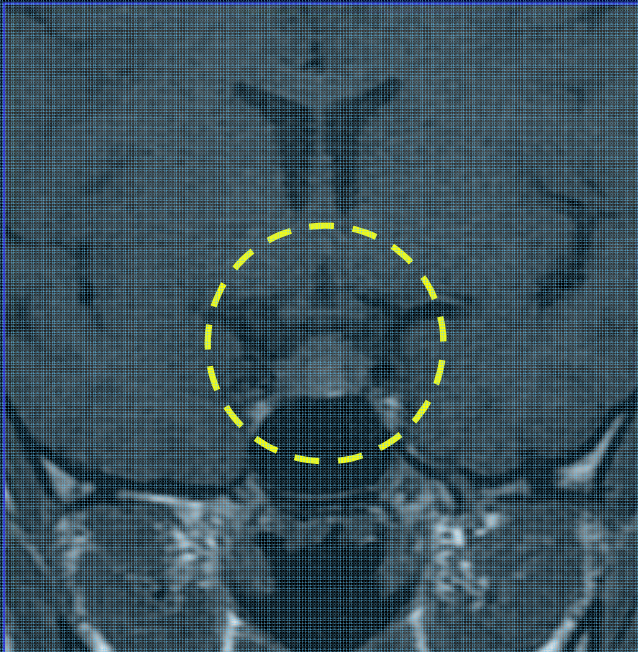
29/10/2009



14/5/2010

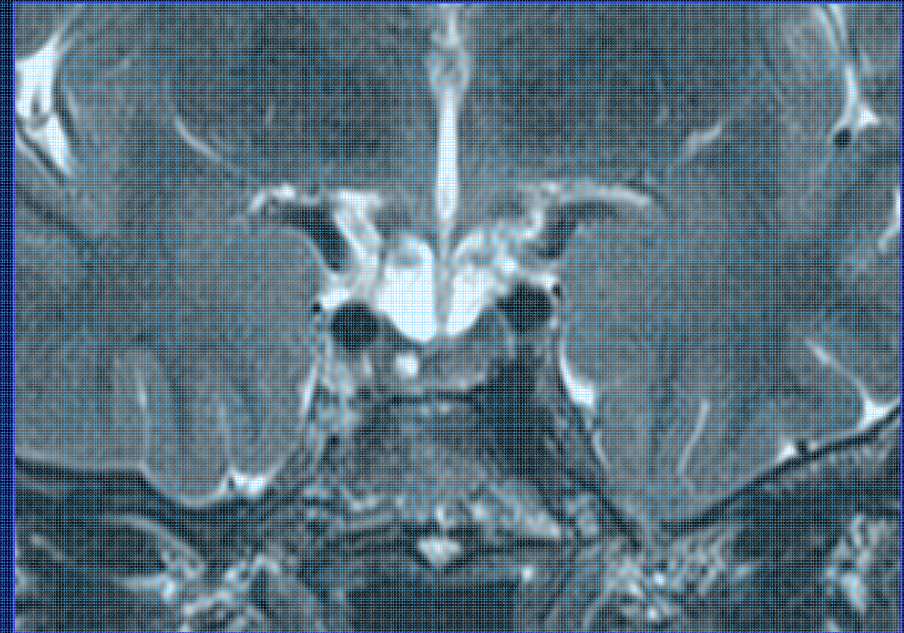
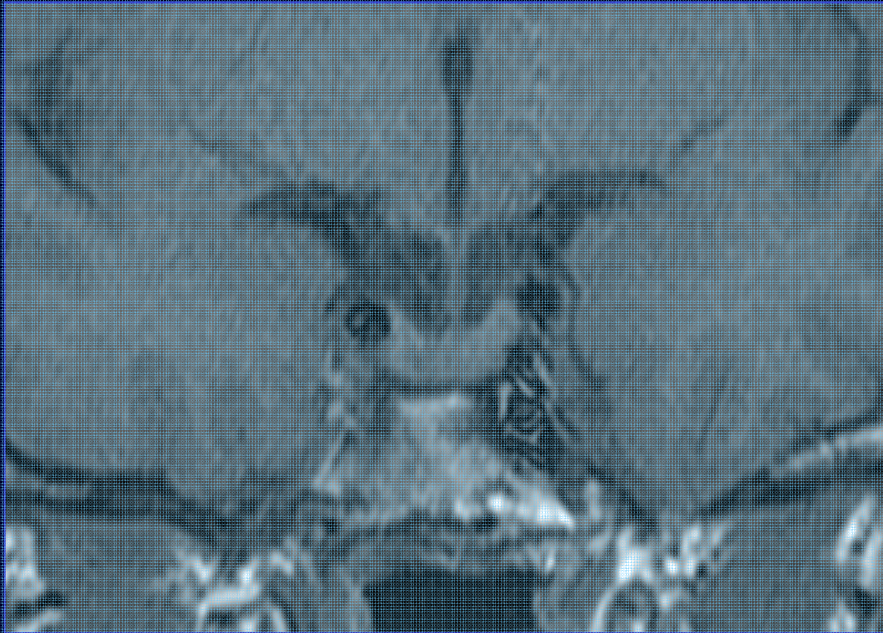


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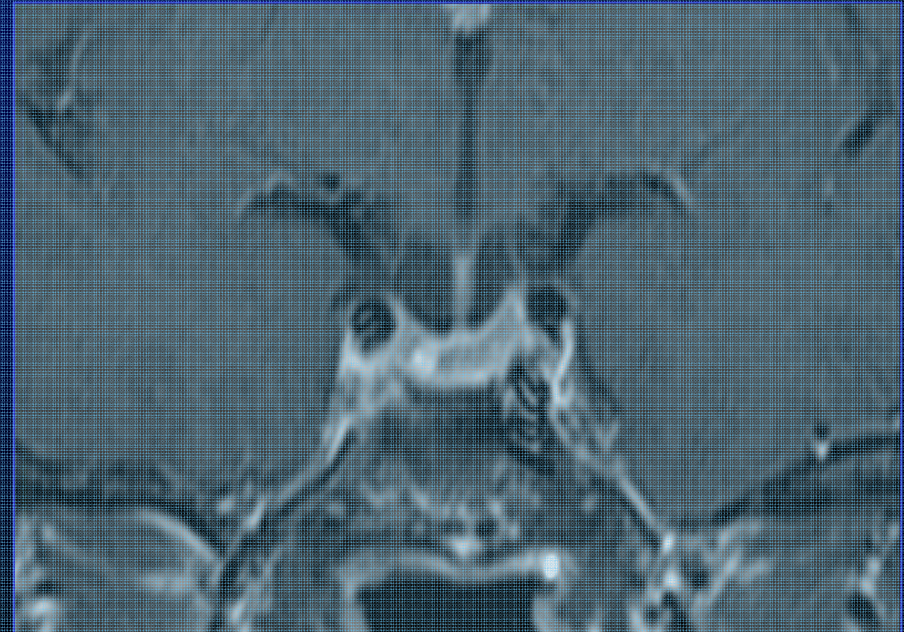
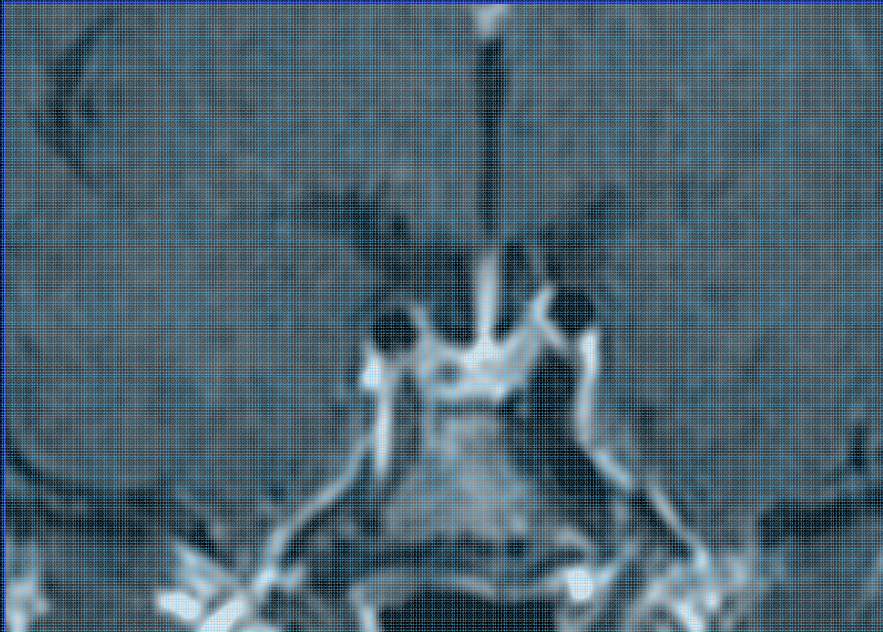


MICROADENOMA IPOFISARIO

MdC

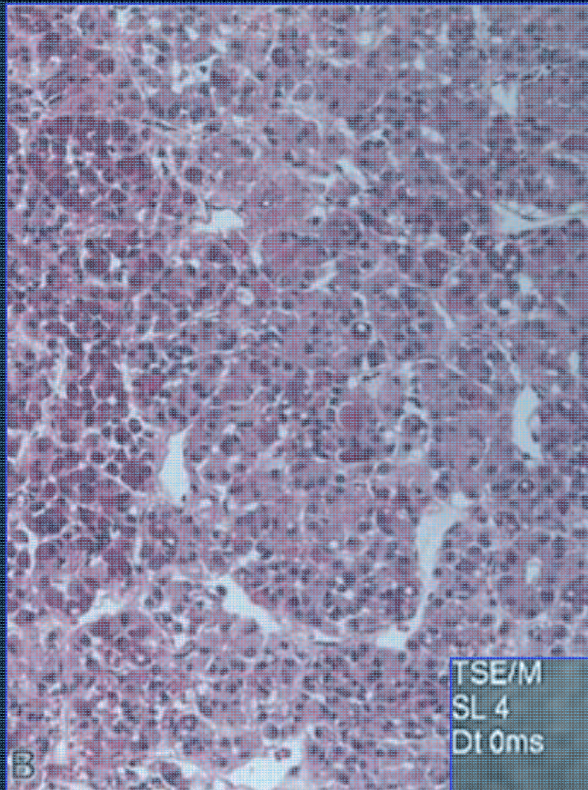


“flip-flop”

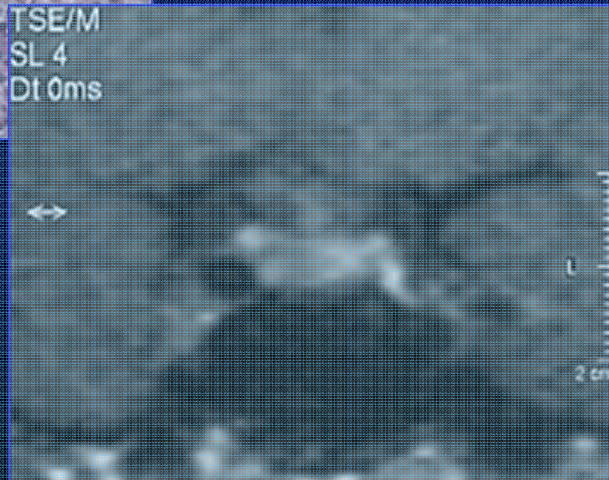


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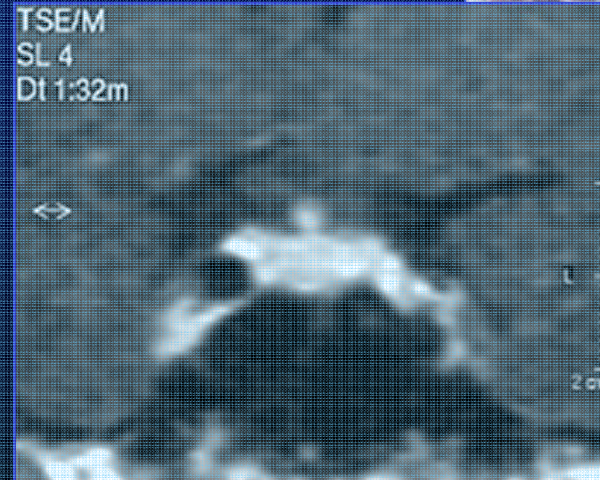
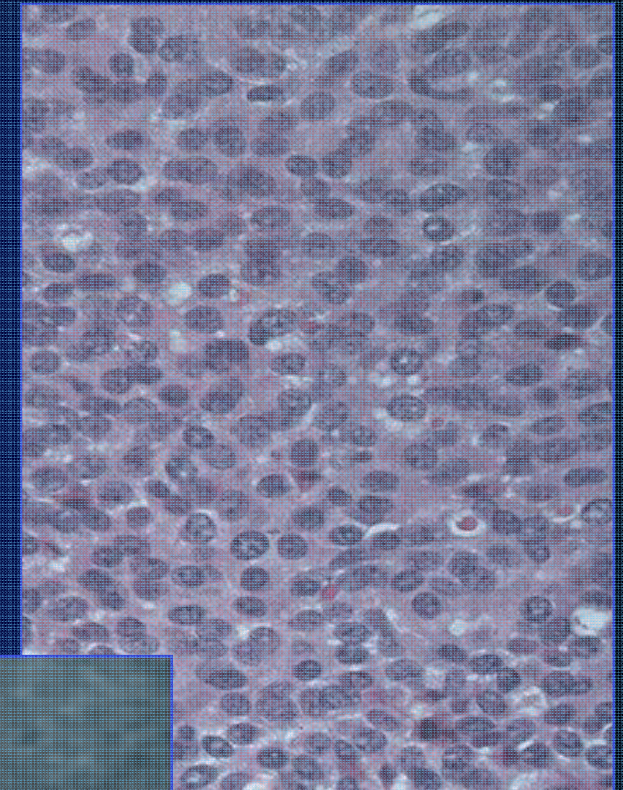
IPOFISI NORMALE



- ✓ cellule poligonali uniformi
- ✓ tessuto connettivo scarso
- ✓ attività mitotica modesta

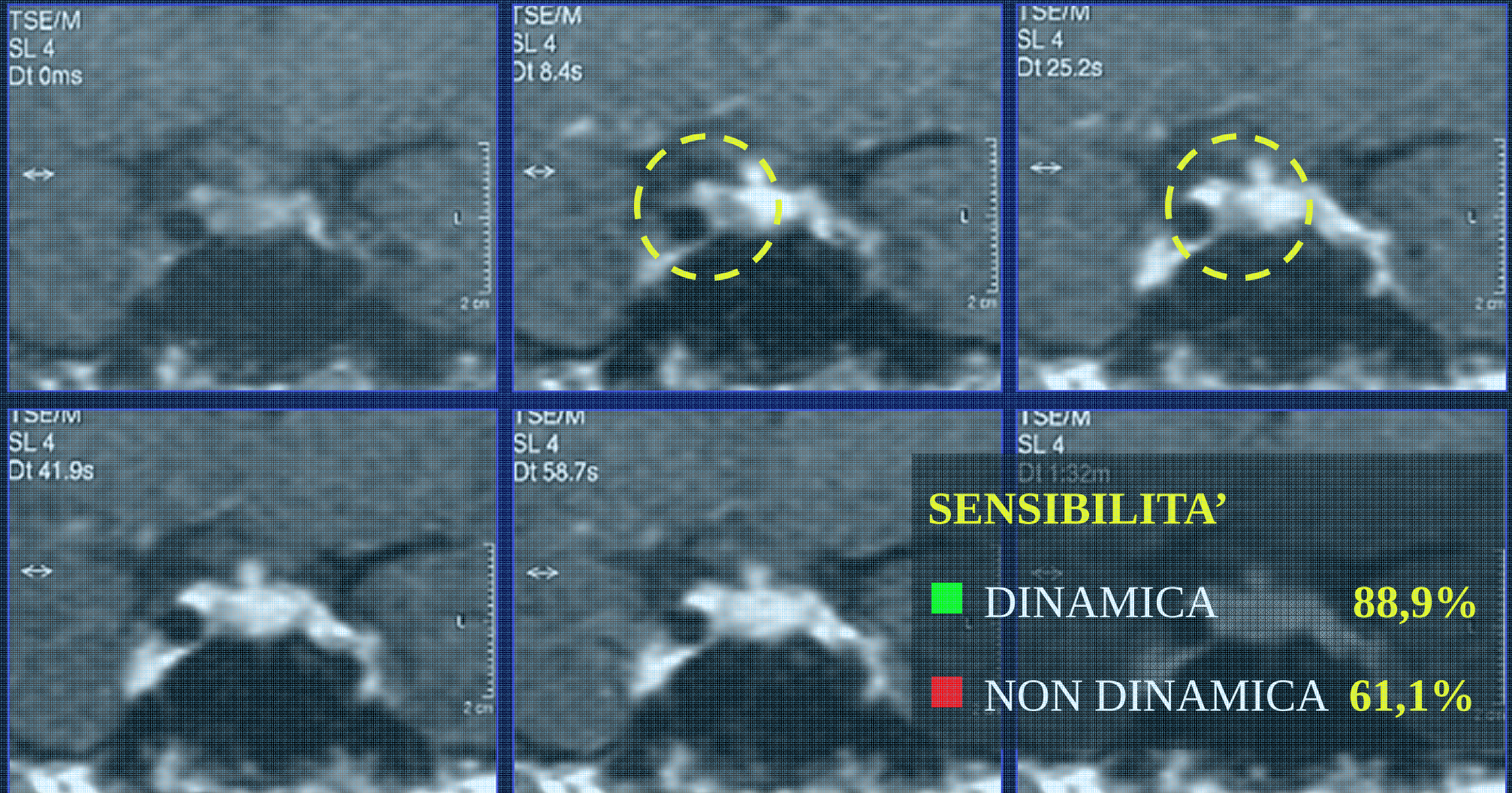


ADENOMA IPOFISARIO



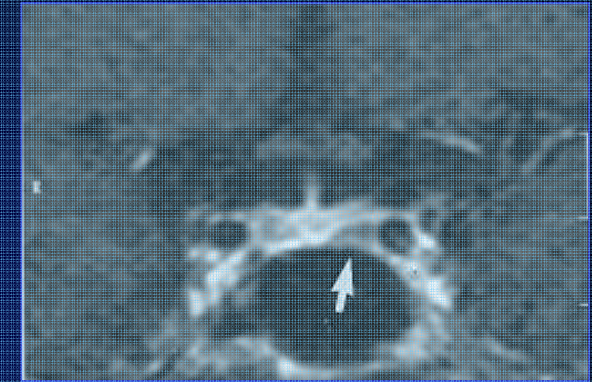
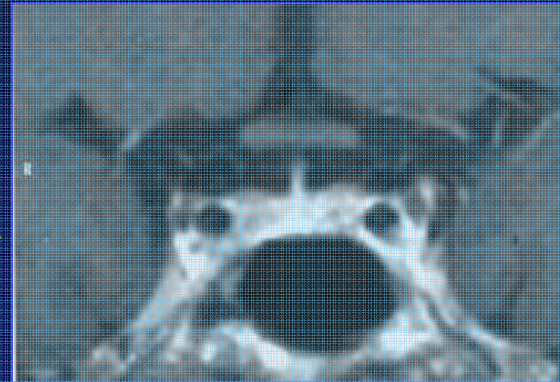
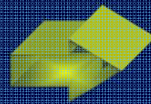
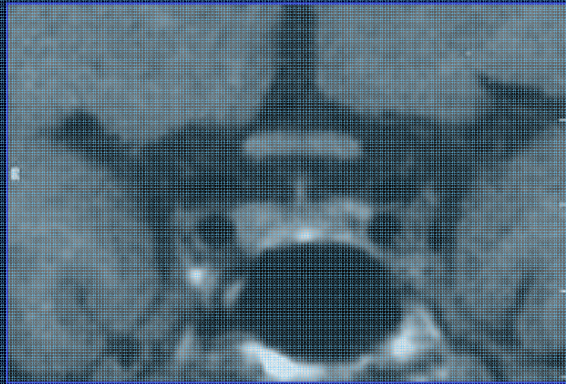
MICROADENOMA IPOFISARIO

RM DINAMICA



Bartynski WS, et Al: *The effect of MR contrast medium dose on pituitary gland enhancement, microlesion enhancement and pituitary gland-to-lesion contrast conspicuity.* **Neuroradiology** 48 449-459, 2006.

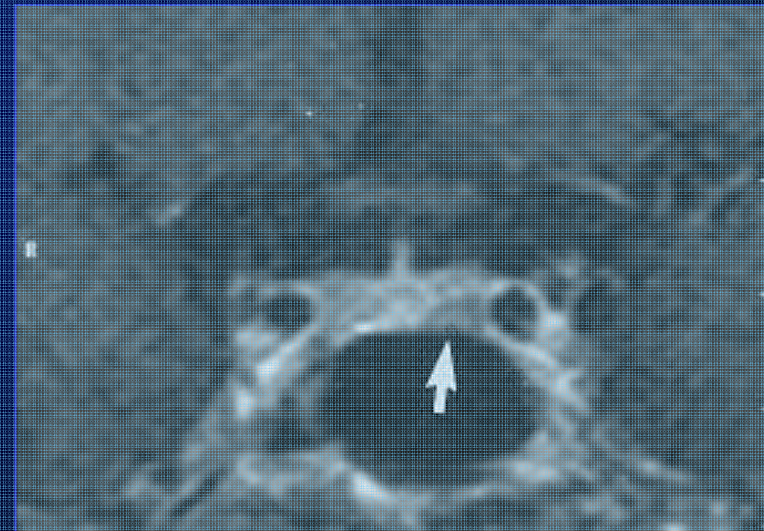
MALATTIA DI CUSHING



SENSIBILITA'

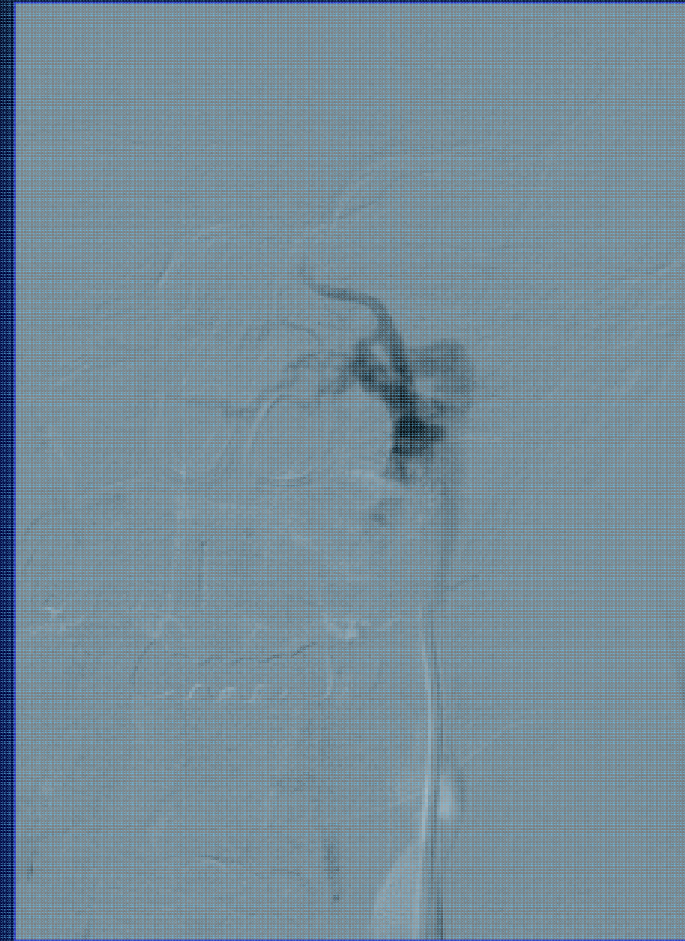
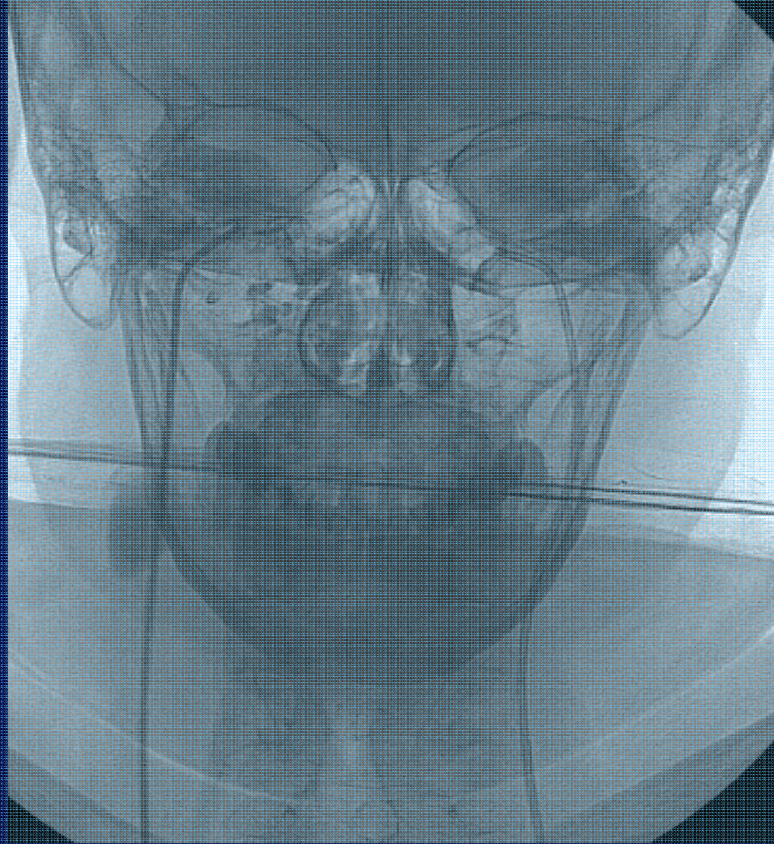
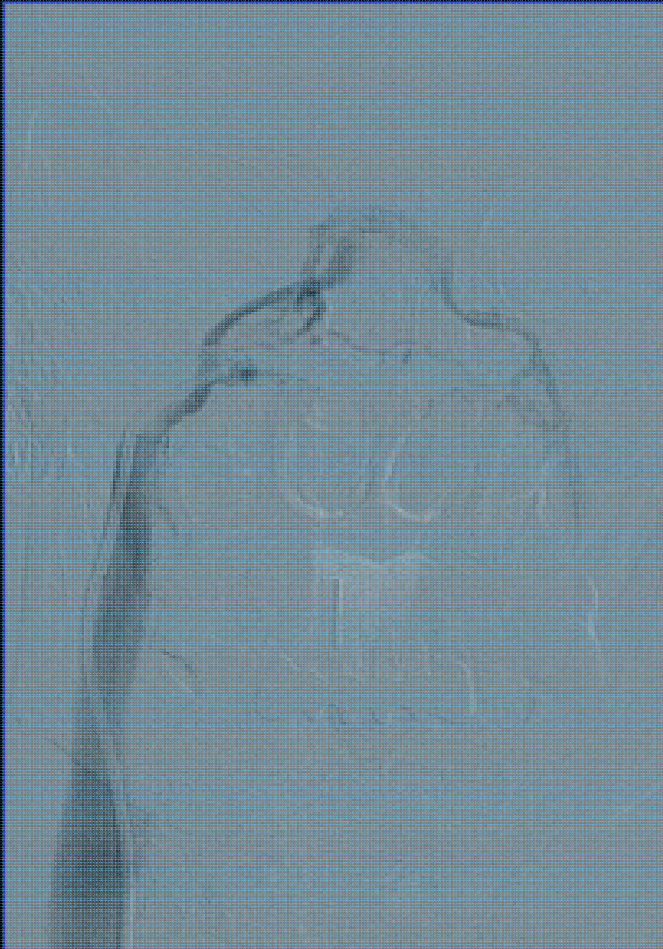
■ DINAMICA 67%

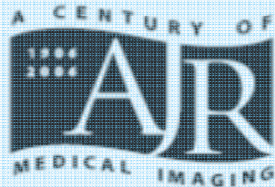
■ NON DINAMICA 52%



Tabarin A, et Al: Comparative evaluation of conventional and dynamic magnetic resonance imaging of the pituitary gland for the diagnosis of Cushing's disease. Clin Endocrinol (Oxf). 1998 Sep;49(3):293-300.

MICROADENOMA IPOFISARIO





Bilateral Inferior Petrosal Sinuses Sampling in the Routine Investigation of Cushing's Syndrome: A Comparison with MRI

La presenza di un gradiente significativo di ACTH tra il sangue periferico e quello prelevato dal seno petroso inferiore è diagnostico per S.Cushing da secrezione ipofisaria...la sua assenza è diagnostica per sindrome da secrezione ectopica di ACTH

CRITERI DIAGNOSTICI

- incremento ACTH $> 50\%$ dopo somministrazione di CRH (criterio biochimico)
 - IPS / P gradiente > 2

MALATTIA DI CUSHING

VARIABILI MRI

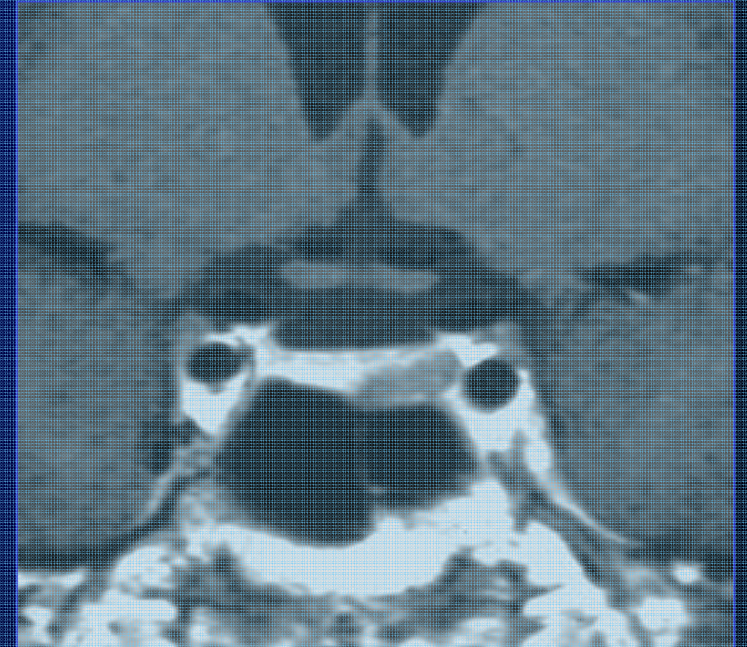
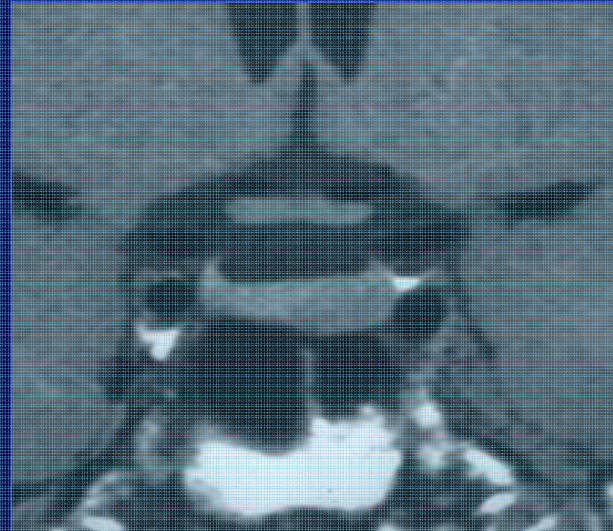
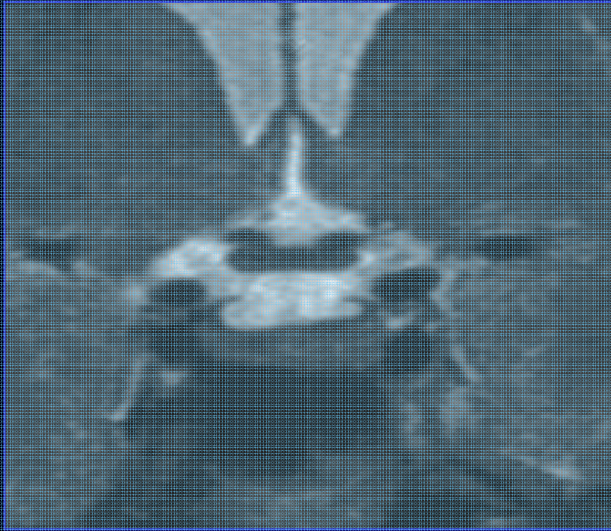


1.5 T > 3 T

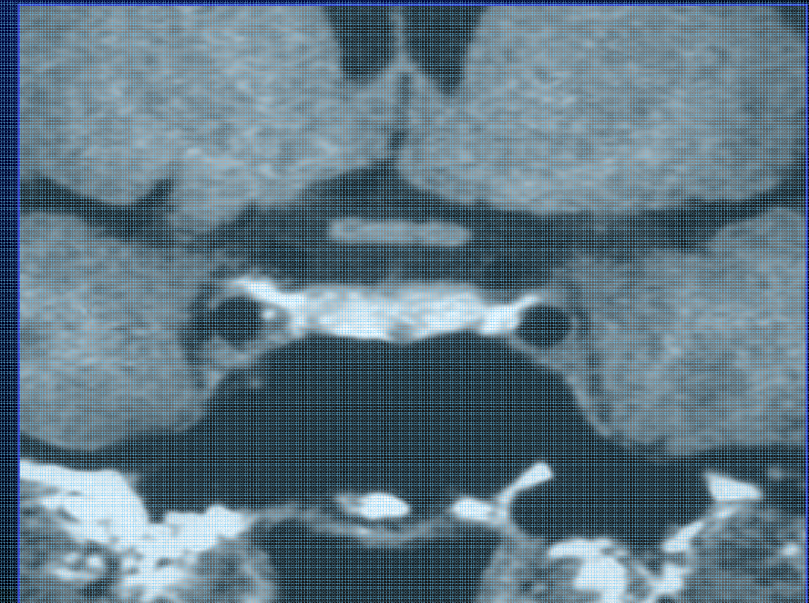
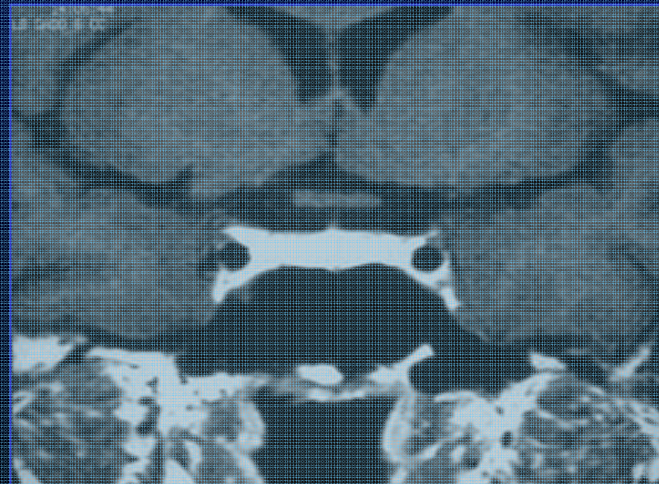
DOSAGGIO
GADOLINIO

SEQUENZE:
DINAMICHE
SPIN-ECHO,
SPGR o VI-SGE

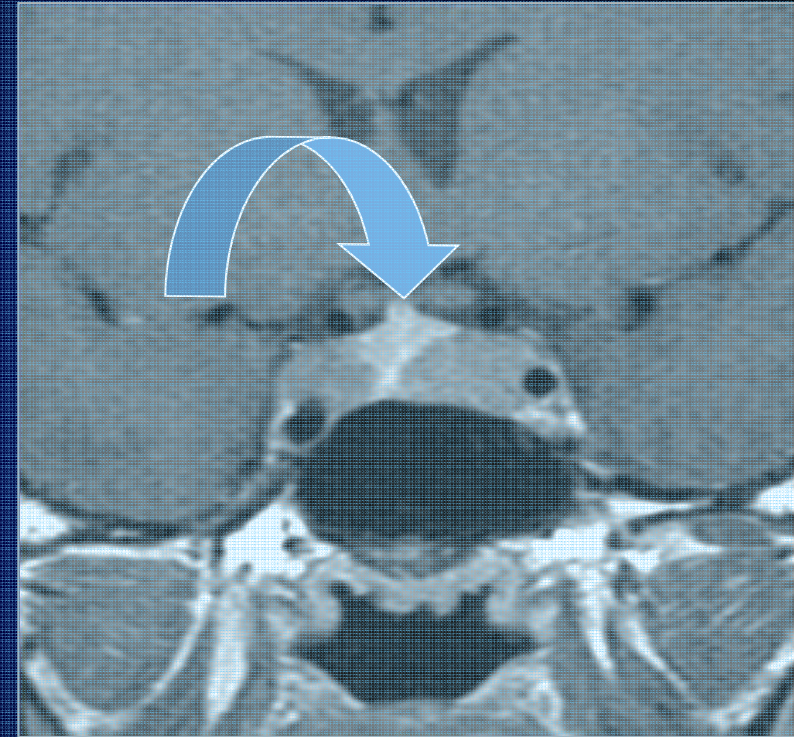
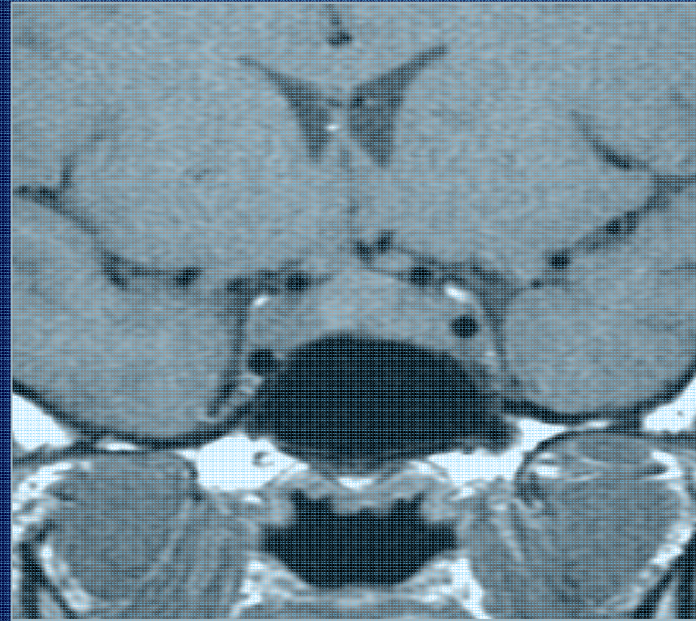
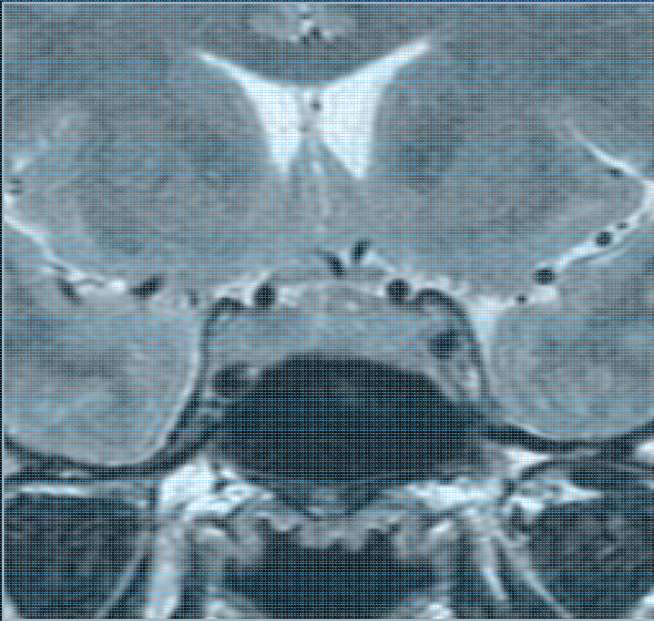
Gadolinio



mezza-dose !!



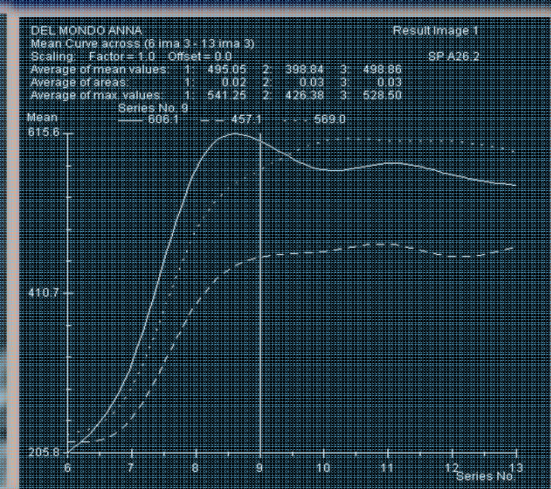
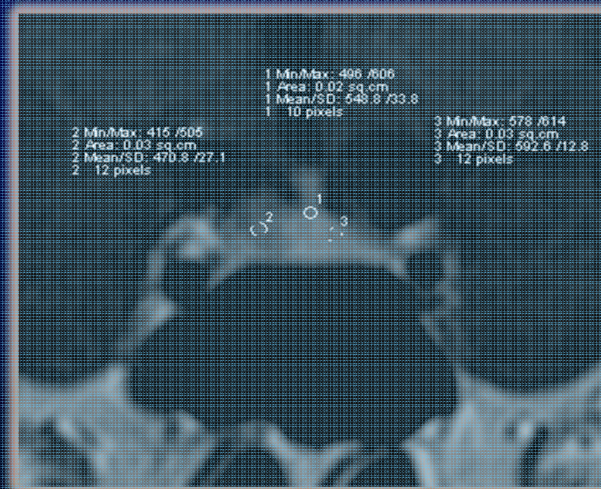
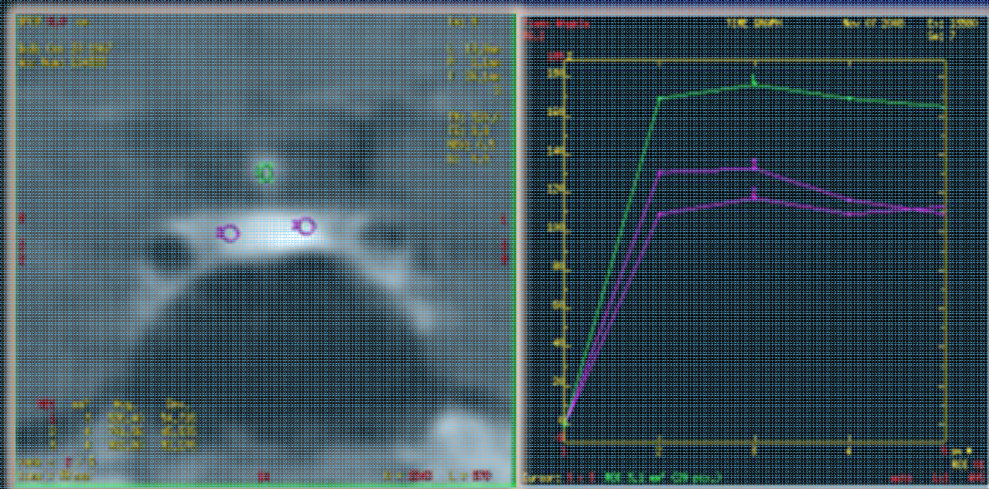
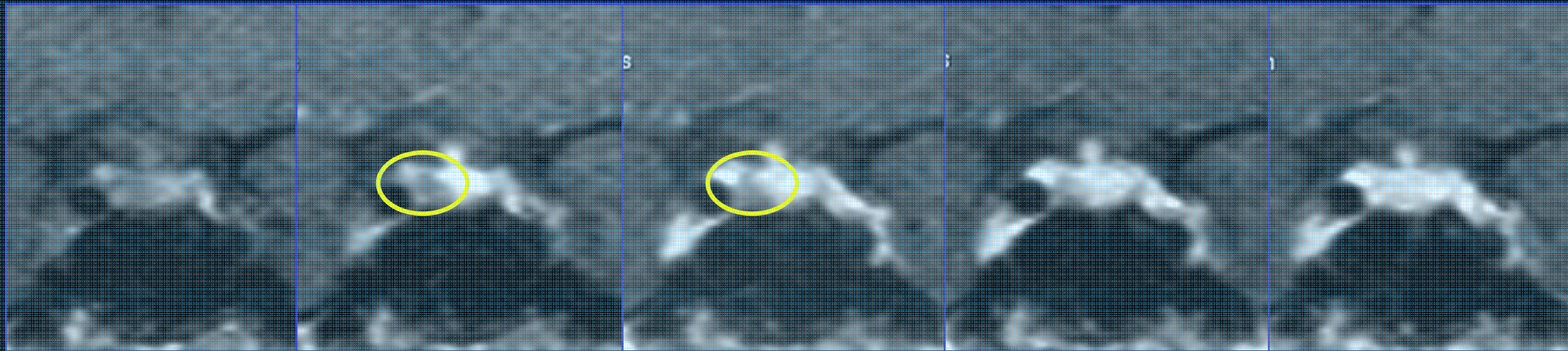
Gadolinio



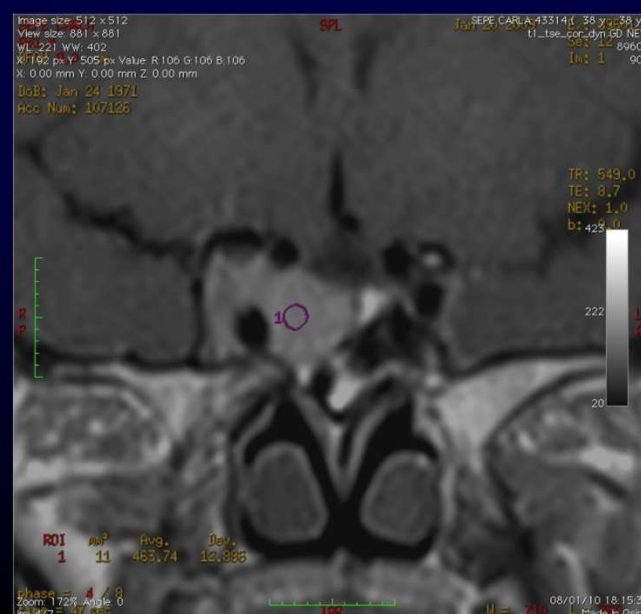
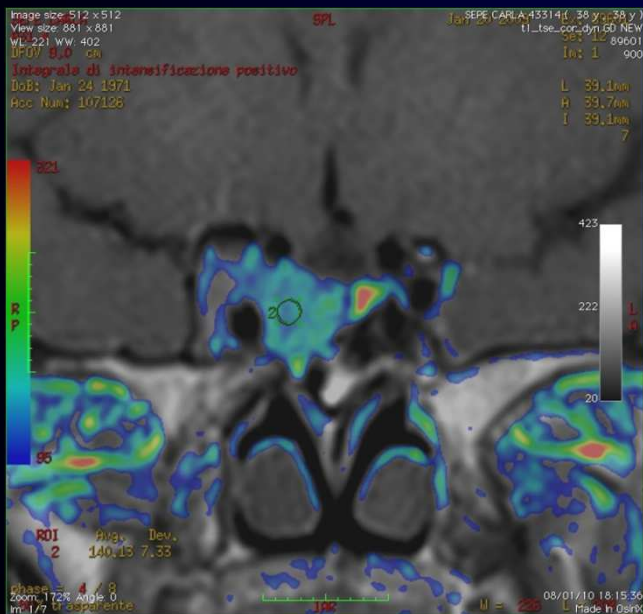
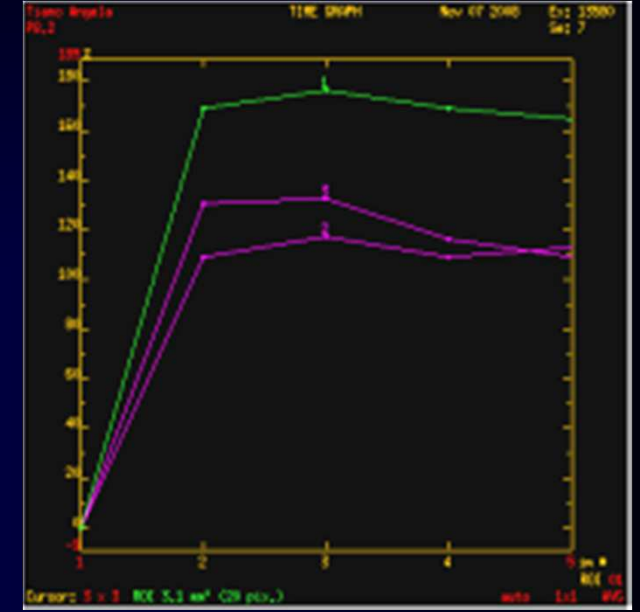
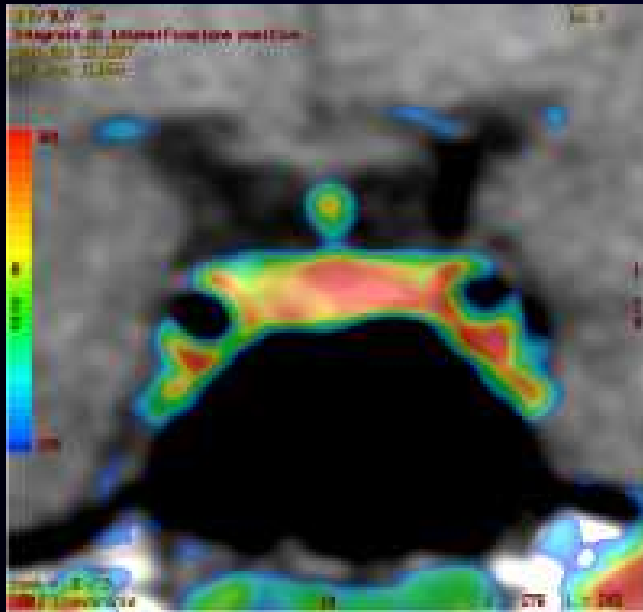
...maggiore impregnazione dell'adenoipofisi!!

PATOLOGIA IPOFISARIA

✓ DynamicMR imaging



✓ tecniche aggiuntive : mdc dinamico



MALATTIA DI CUSHING

SCELTA DELLA SEQUENZA DI STUDIO: SPIN-ECHO, o VI-SGE

- ✓ **strato sottile** (1-3 mm)
- ✓ **piano sagittale** (logge cavernose)
- ✓ **piano coronale** (peduncolo ipofisario)
- ✓ **piano assiale** (pavimento sellare)

SEQUENZA Spin-Echo 1.5T

TR/TE: 400/9 msec.

FOV: 12*12cm.

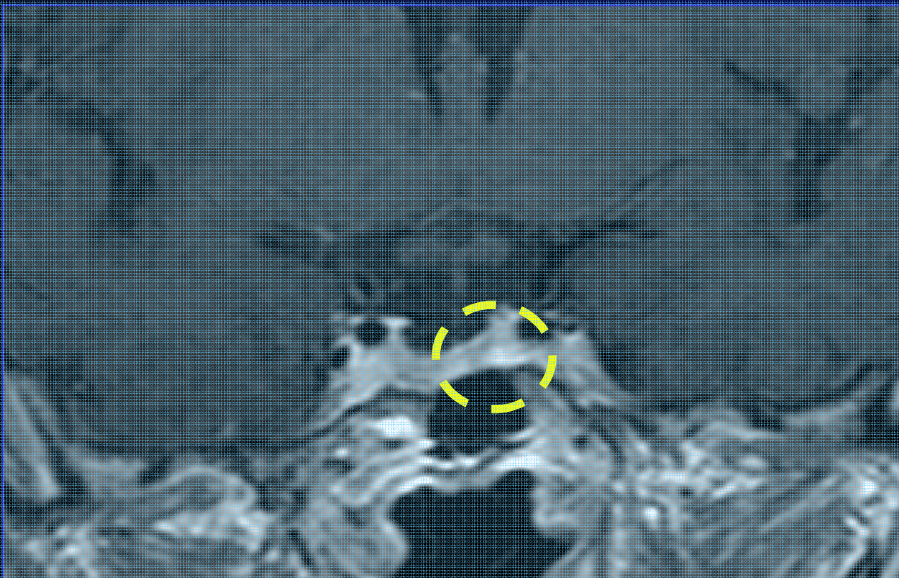
Slice Thickness: 3mm.

SEQUENZA VI-SGE 1.5T

TR/TE: 10/3,3 msec.

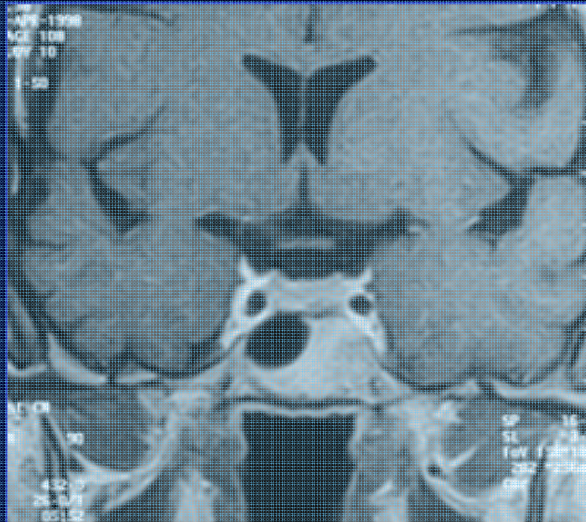
FOV: 16*16cm.

Slice Thickness: 1-2mm.

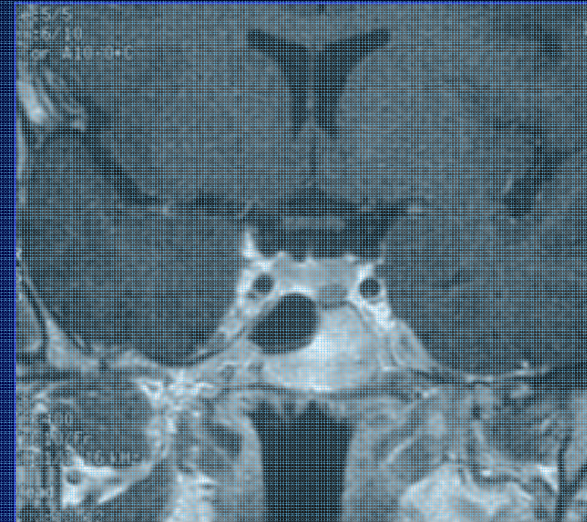


MICROADENOMA IPOFISARIO

ADENOMI ACTH



(TR)/ (TE) 422/26 ms;
(FOV) 15,8 · 18,0 cm.



TR/TE 400/10 ms;
FOV 12 · 12 cm.

I PARAMETRI DI ACQUISIZIONE INFLUENZANO I RISULTATI:

“Not all ‘T1-weighted SE scans are equally accurate. MRI technique, particularly FOV and TR/TE value, influences Results “.

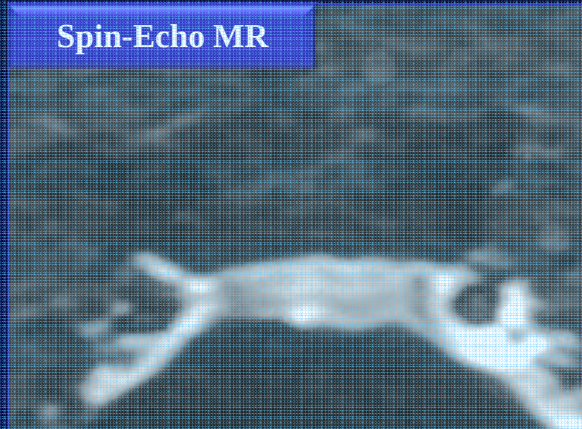
Iffat N. Chowdhury et Al: A change in pituitary magnetic resonance imaging protocol detects ACTH-secreting tumours in patients with previously negative results.
Clinical Endocrinology (2010) 72, 502–506

MICROADENOMA IPOFISARIO

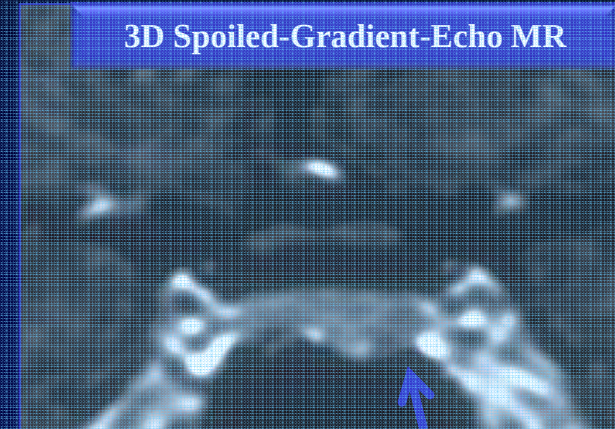
ADENOMI ACTH

SEQUENZE VOLUMETRICHE
HANNO MOSTRATO MAGGIORE
SENSIBILITÀ DIAGNOSTICA,
RICONOSCENDO ANCHE
ADENOMI DI SOLI 3 mm

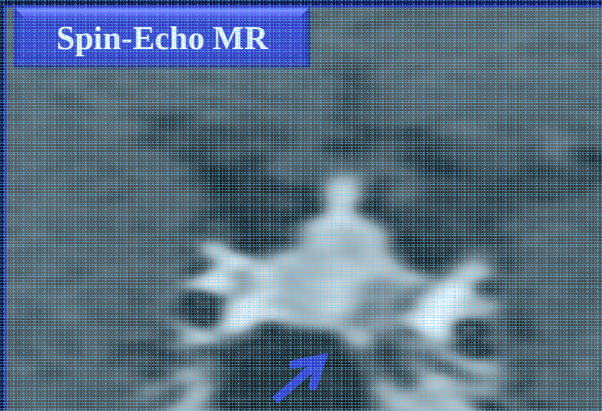
Spin-Echo MR



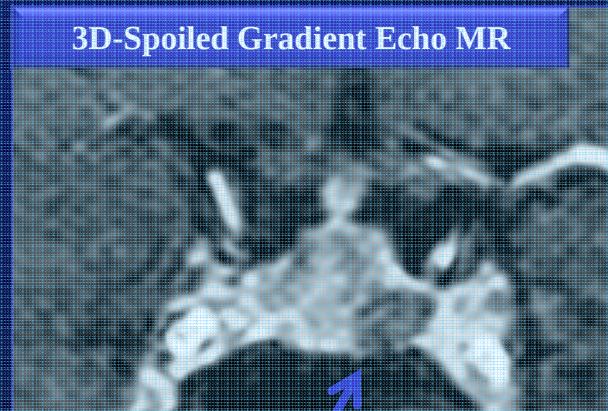
3D Spoiled-Gradient-Echo MR



Spin-Echo MR



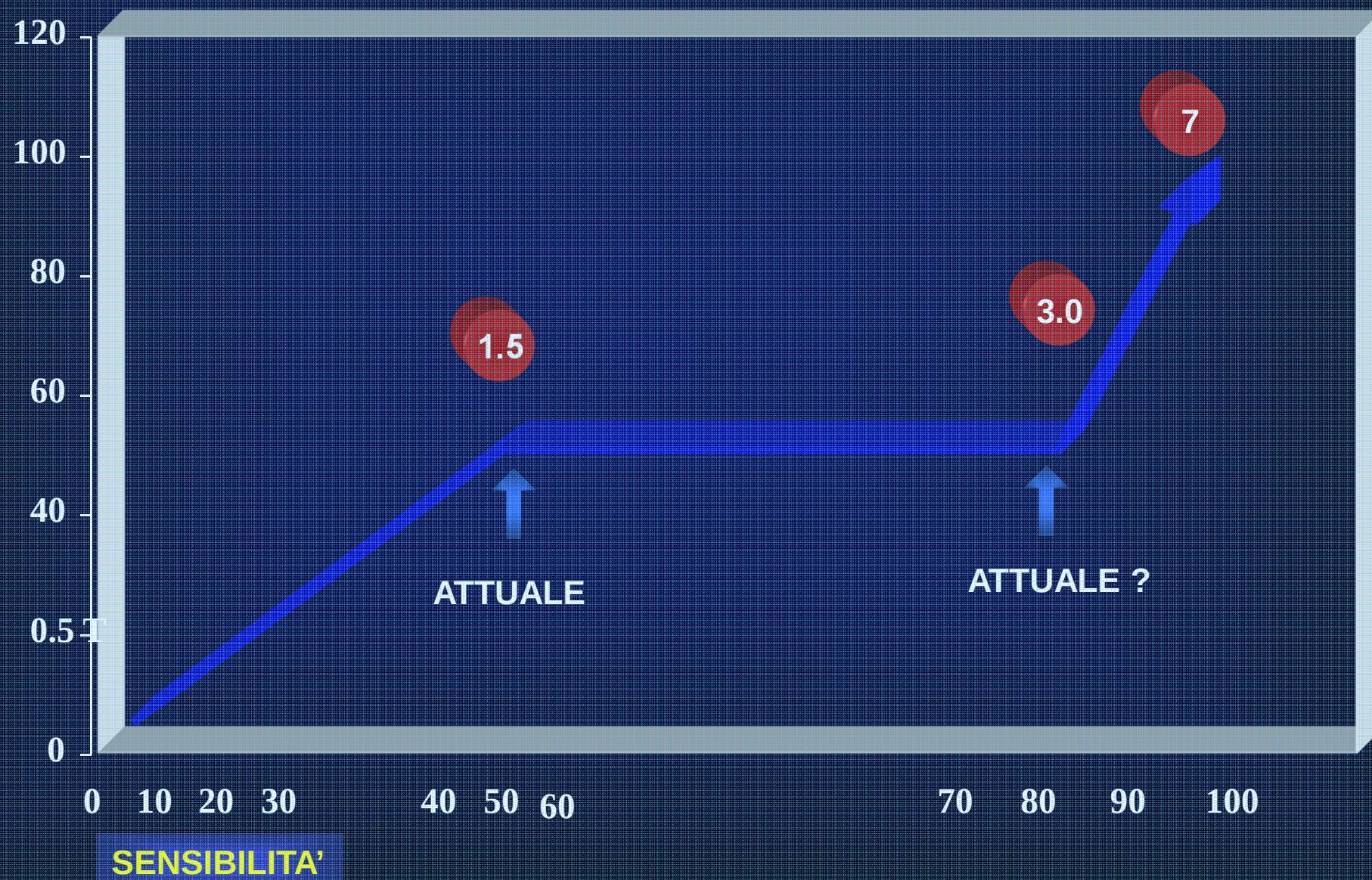
3D-Spoiled Gradient Echo MR



Kasaliwal R, et Al: *Volume interpolated 3D-spoiled gradient echo sequence is better than dynamic contrast spin echo sequence for MRI detection of corticotropin secreting pituitary microadenomas.* Clin Endocrinol (Oxf). doi: 10.1111/cen.12069. Epub 2013 Apr 6.

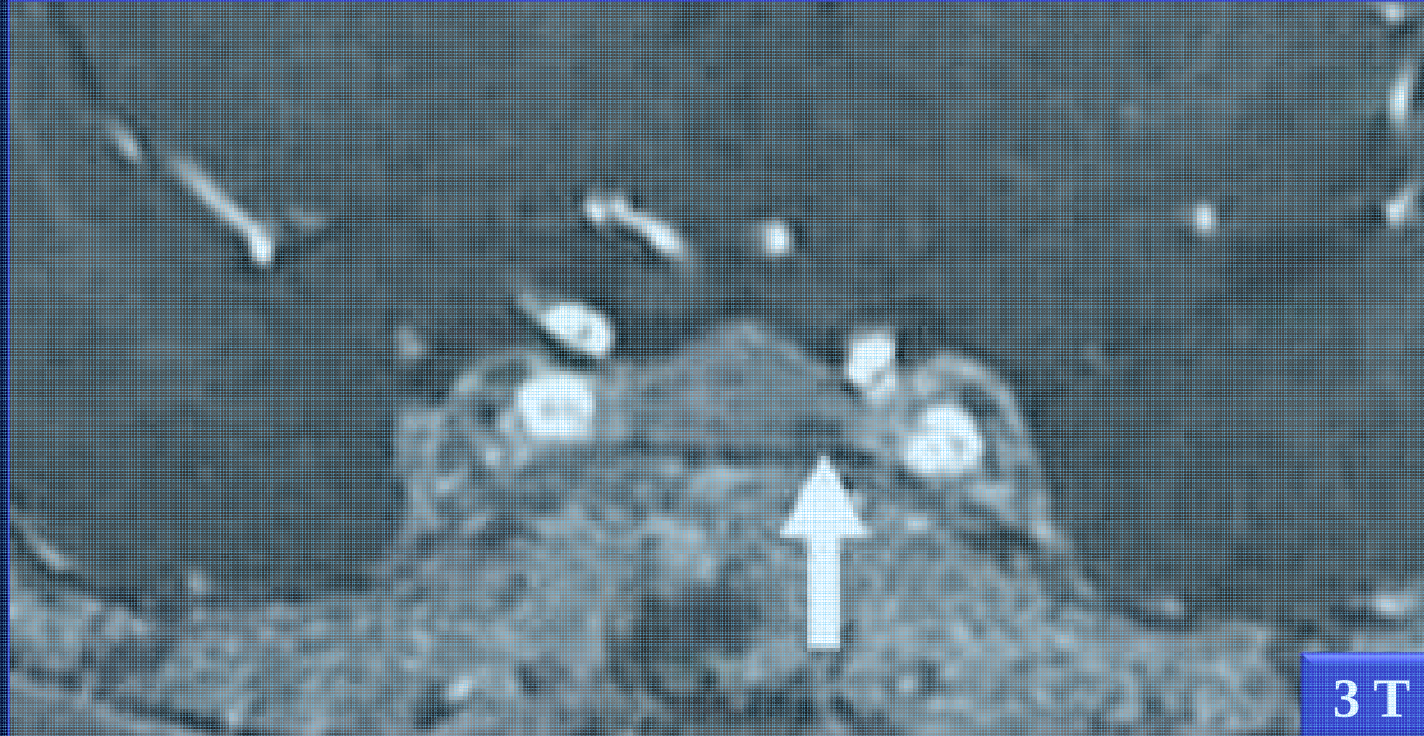
MICROADENOMA IPOFISARIO

CAMPO MAGNETICO



MICROADENOMA IPOFISARIO

ADENOMI ACTH



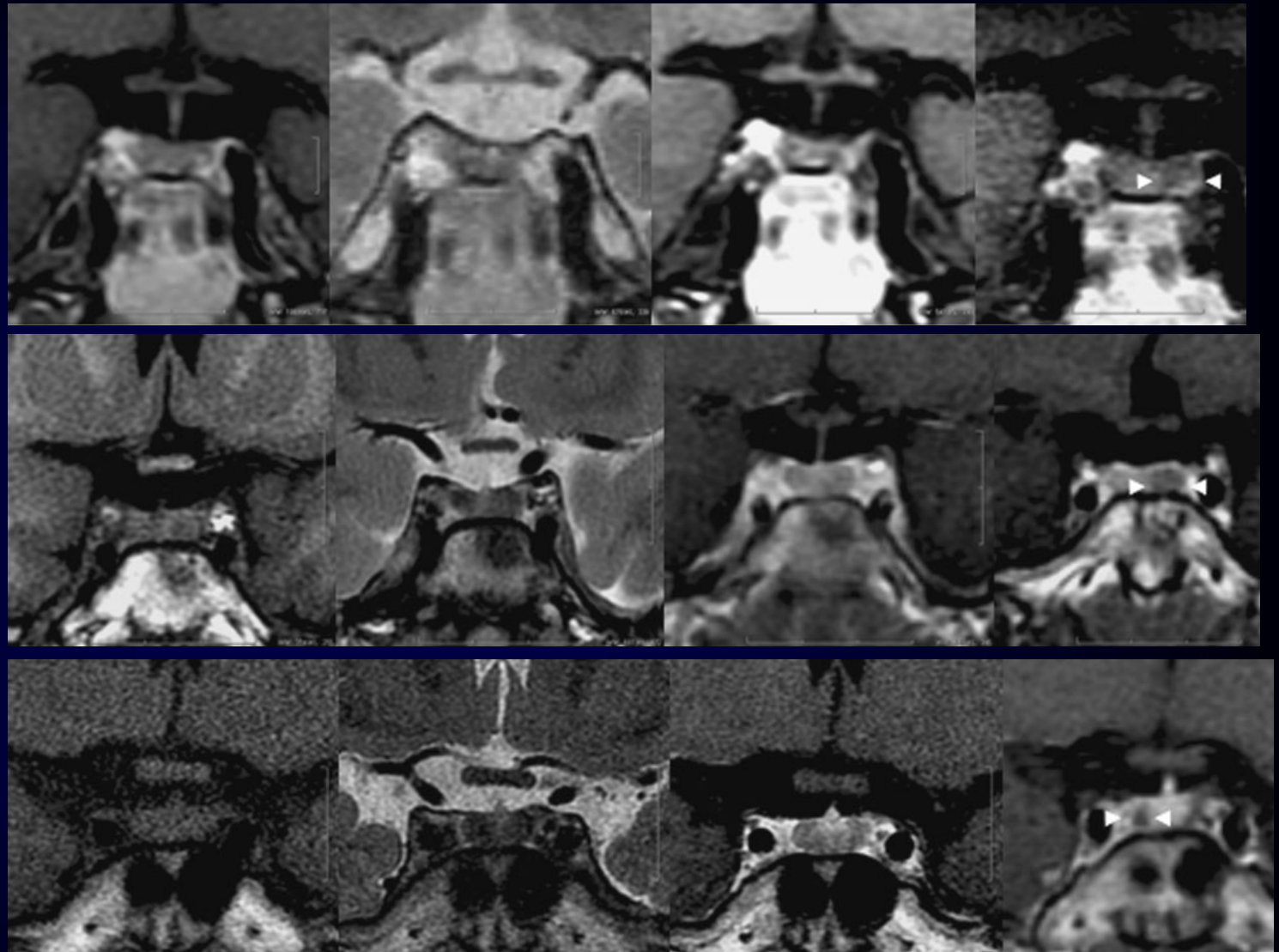
Sensibilità che aumenta anche oltre il limite di 3mm se eseguito ad alto campo (3T)

Ono, E., Ozawa, A., et al: *Diagnostic usefulness of 3 tesla MRI of the brain for cushing disease in a child.*
Clinical Pediatric Endocrinology (2011). 20 (4) , pp. 89-93.

MICROADENOMA IPOFISARIO

- ✓ Campo magnetico elevato
- ✓ TR , TE e FOV
- ✓ Dose gadolinio

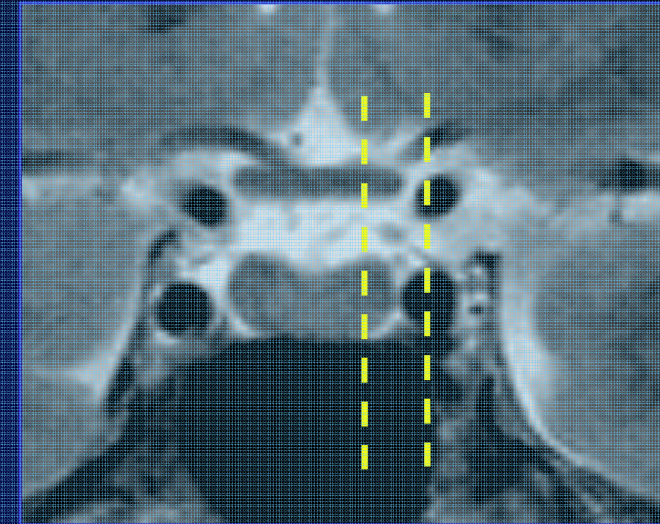
SENSIBILITA' 100 %



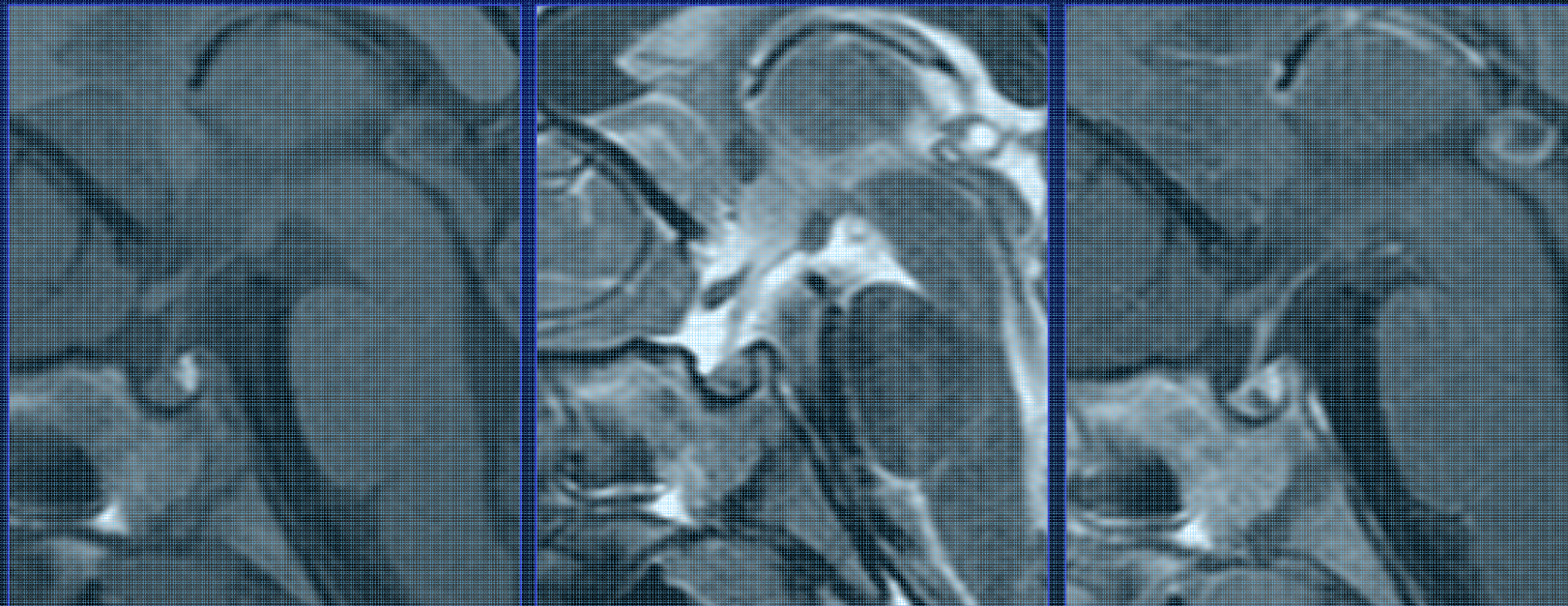
*Lesly Portocarrero-Ortiz et al: A modified protocol using half-dose gadolinium in dynamic 3-Tesla magnetic resonance imaging for detection of ACTH-secreting pituitary tumors
Pituitary (2010) 13:230–235*

DIAGNOSI DIFFERENZIALE

FALSI POSITIVI



CISTI DELLA
PARS INTERMEDIA



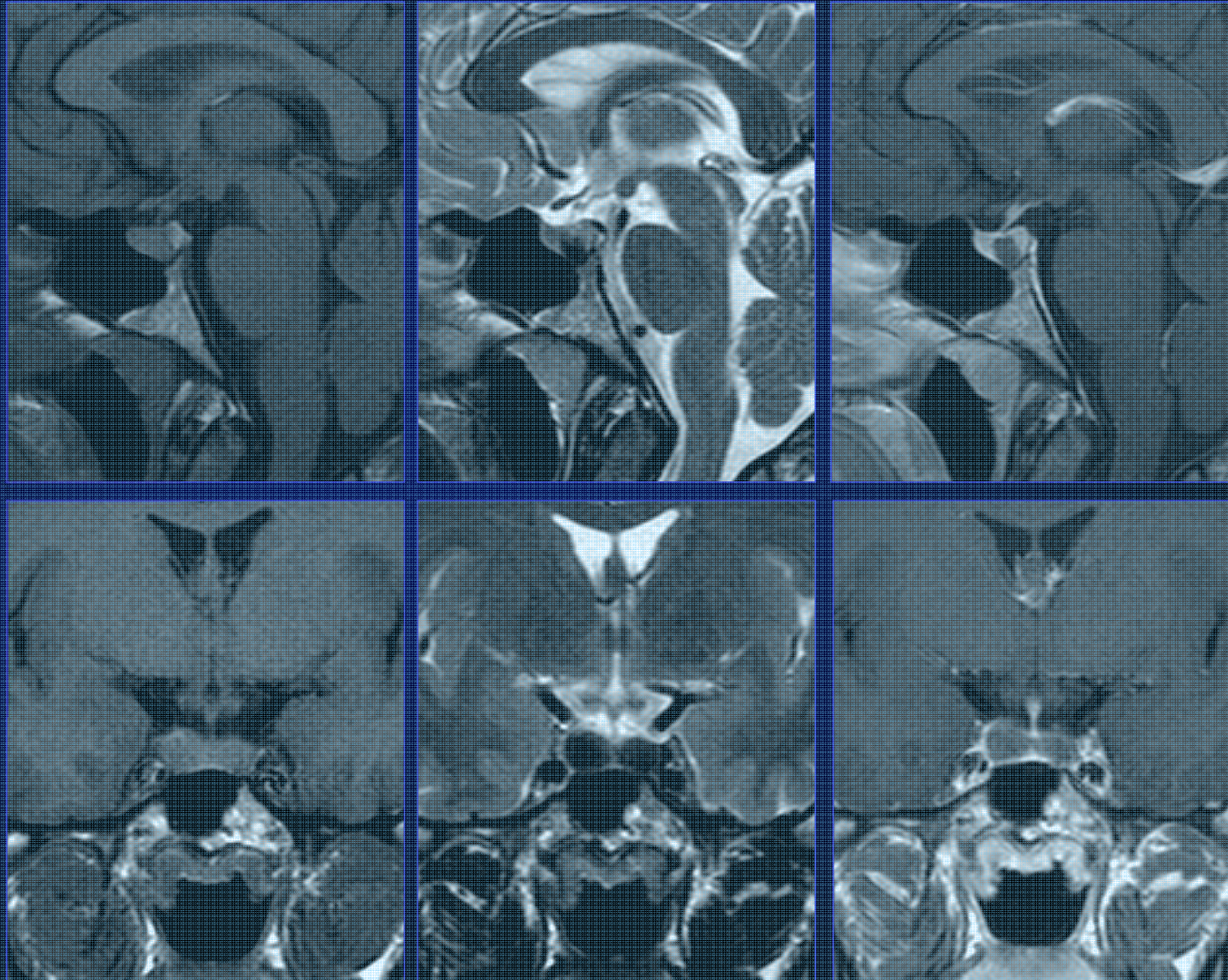
DIAGNOSI DIFFERENZIALE

CISTI DELLA TASCA DI RATHKE

✓ sede

✓ segnale

✓ impregnazione (-)



MACROADENOMA IPOFISARIO: diagnosi differenziale

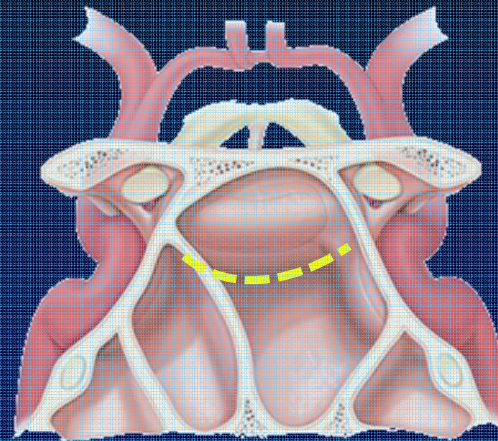
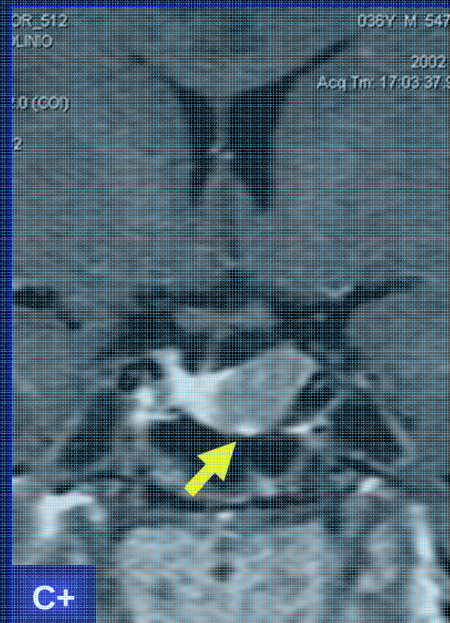
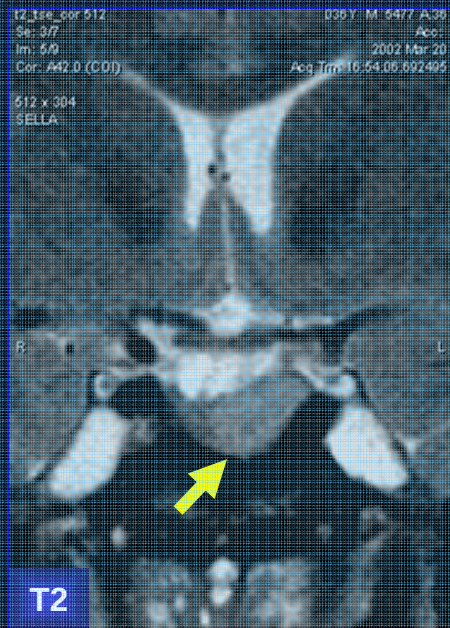
MACROADENOMA



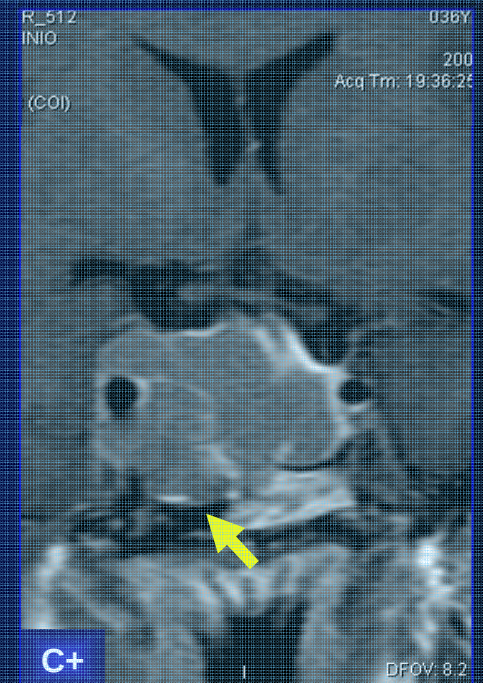
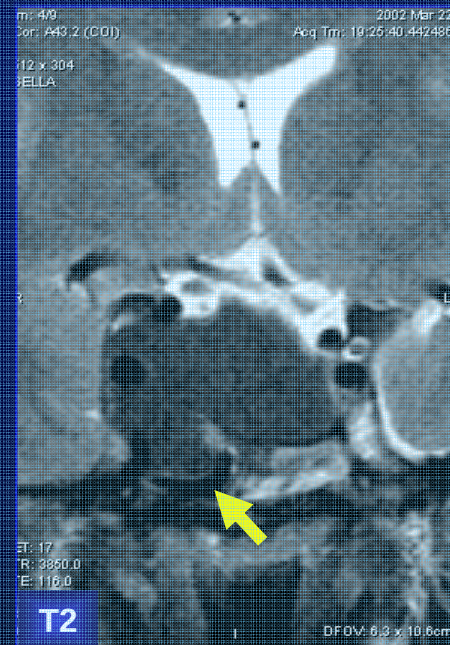
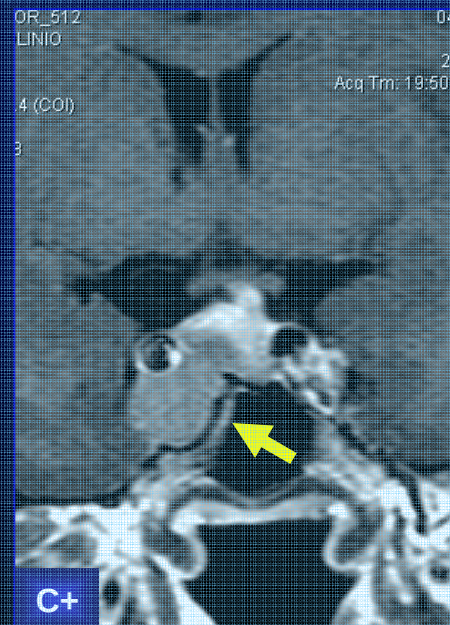
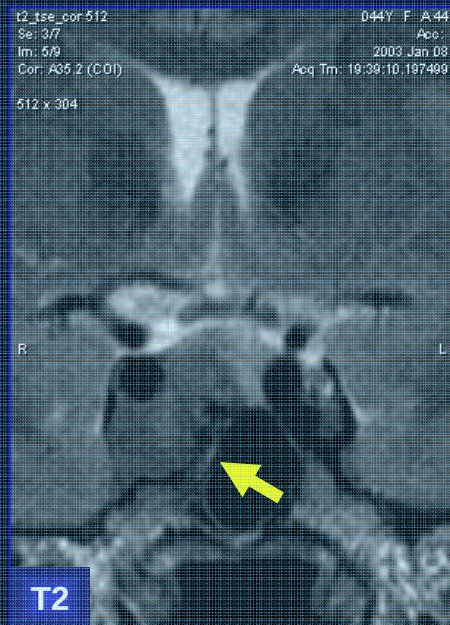
CISTI DI RATHKE



MACROADENOMA IPOFISARIO: bilancio spaziale

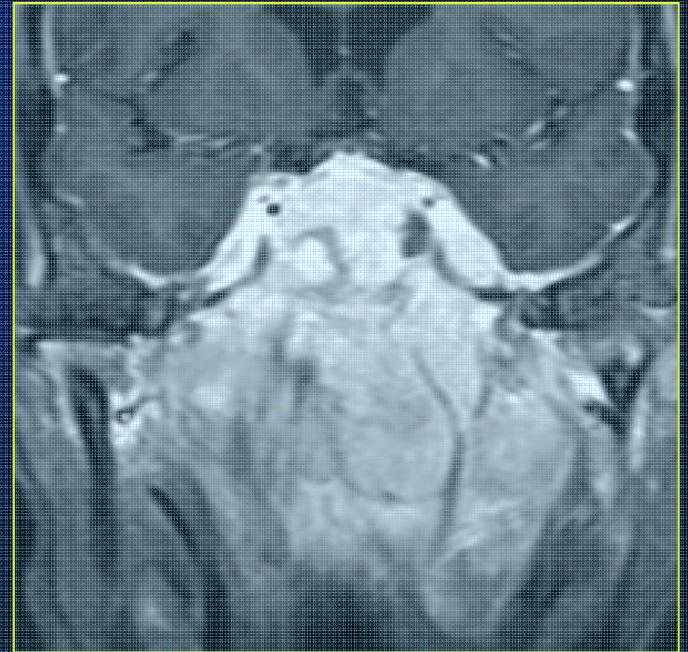
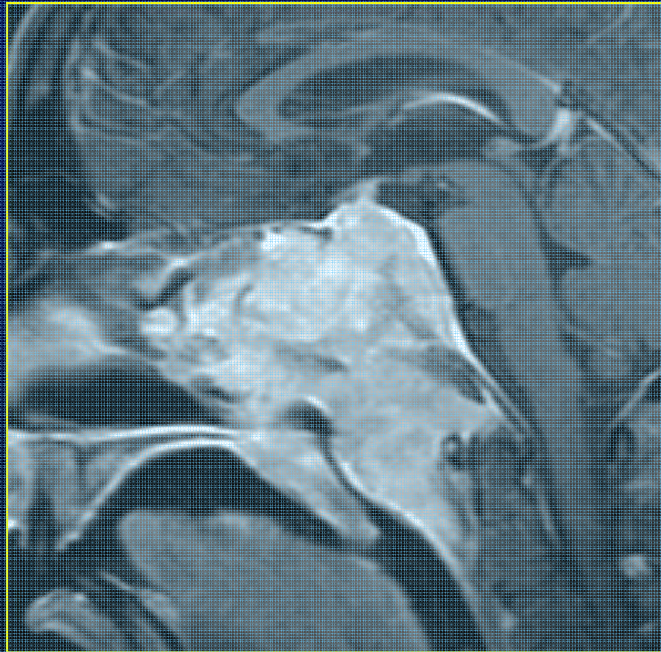
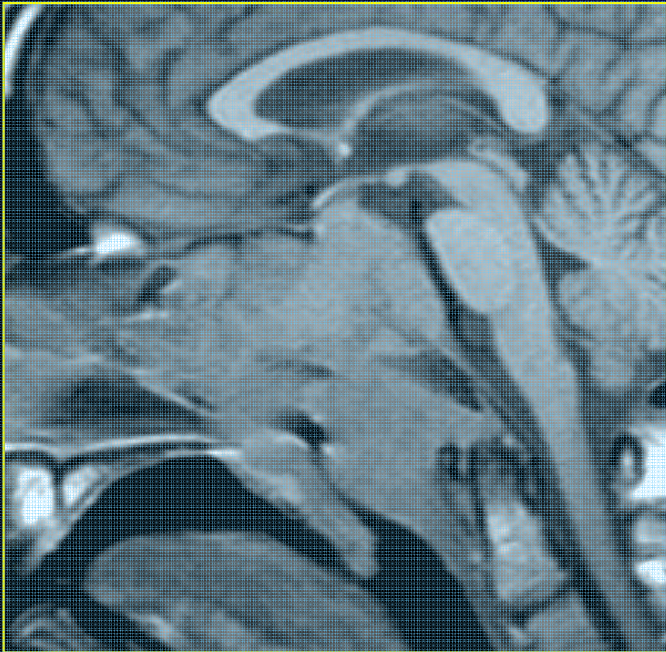
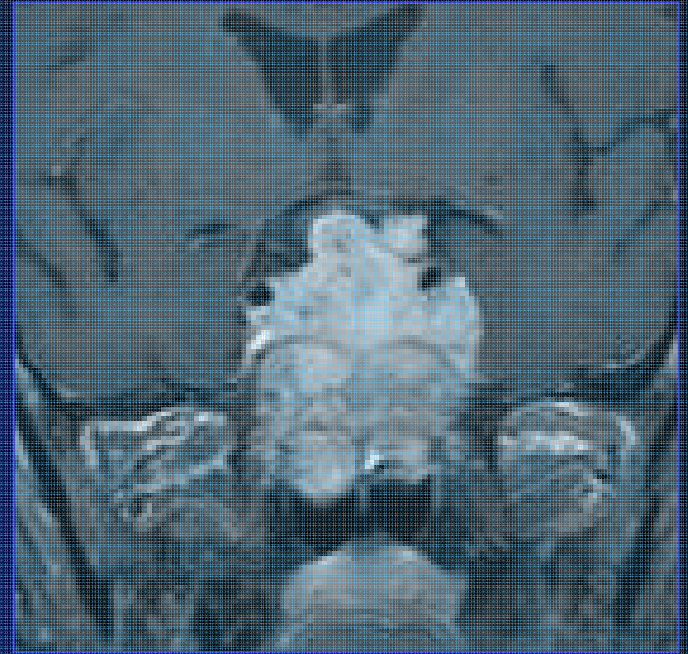
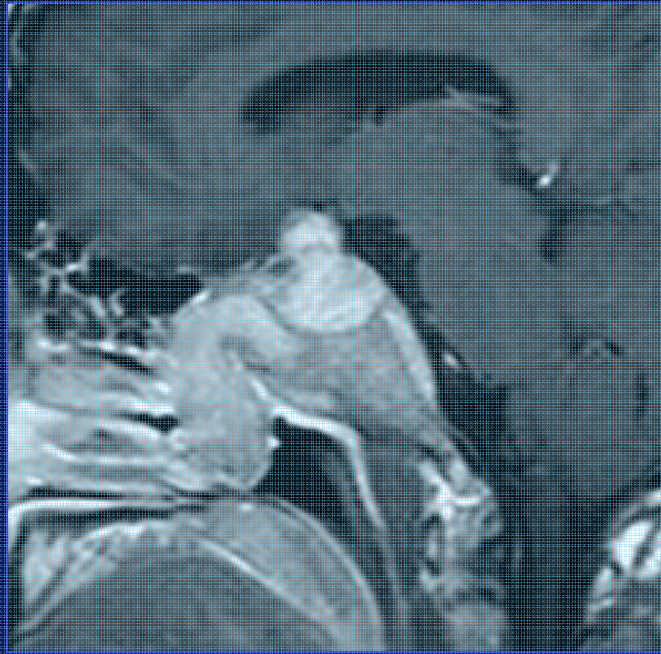
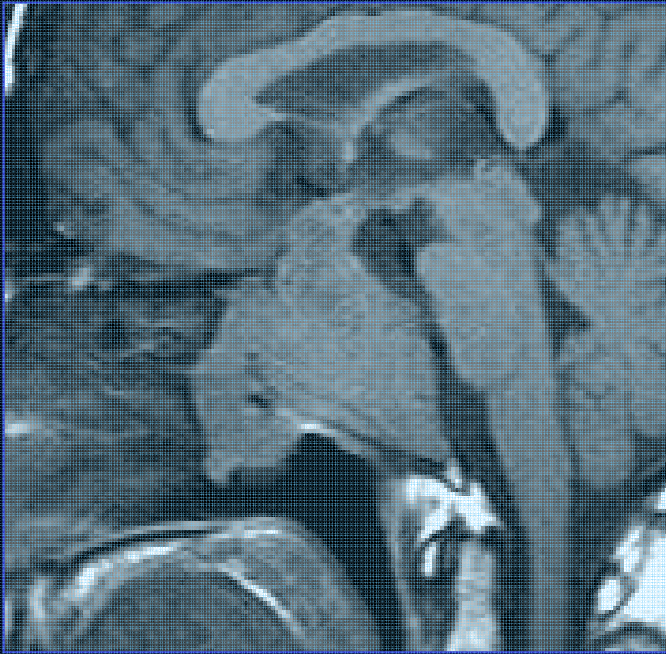


RAPPORTI CON IL
SENO SFENOIDALE



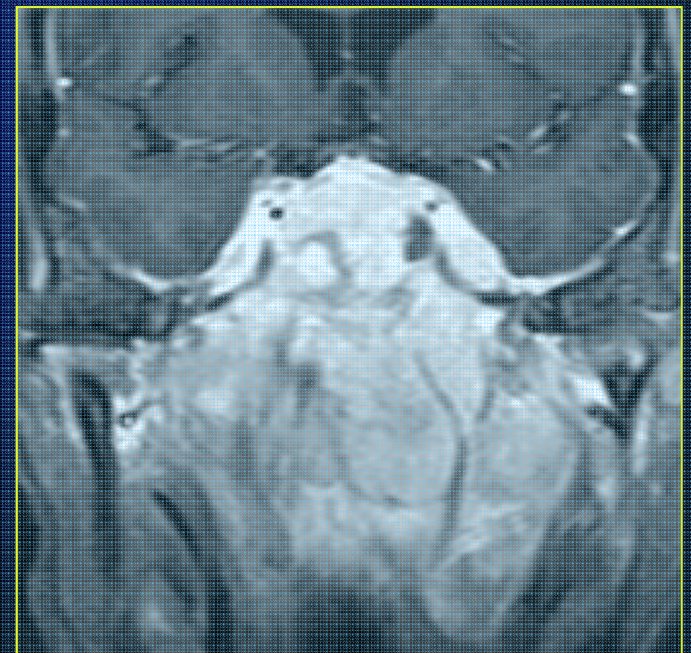
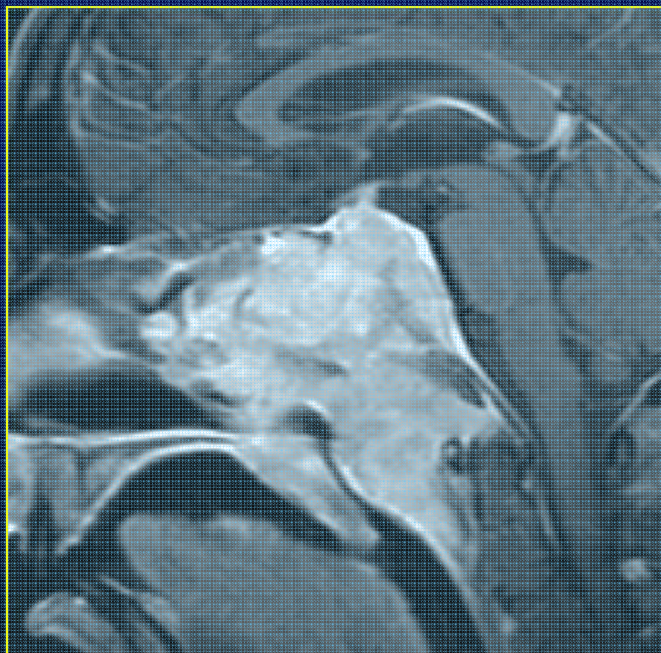
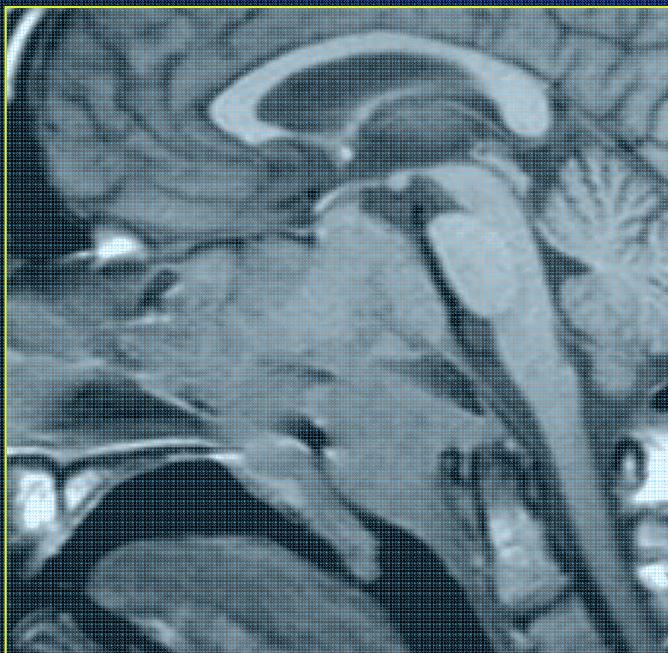
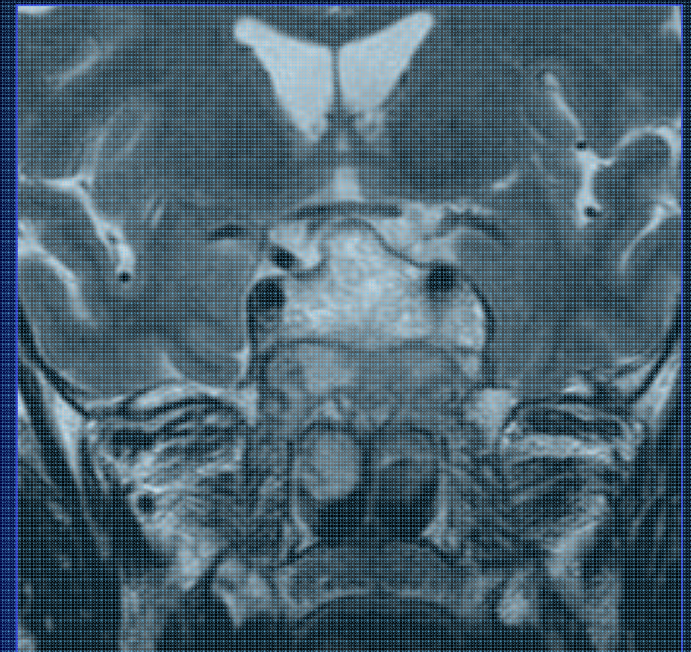
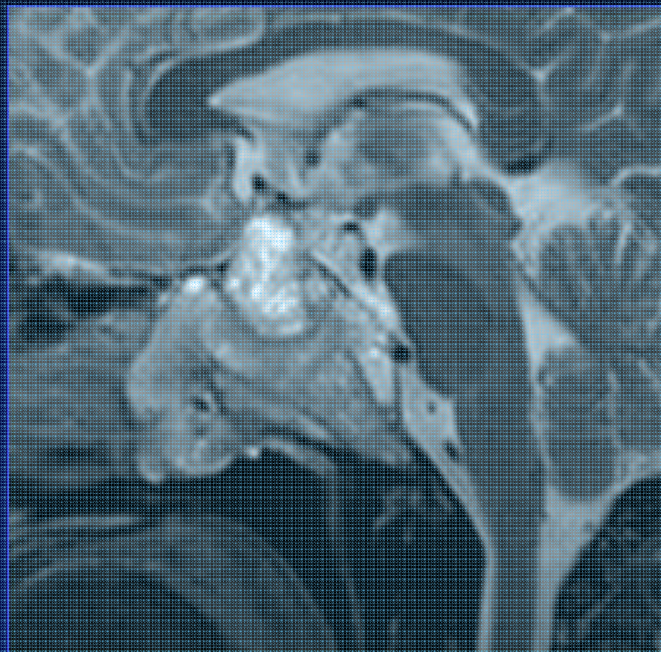
Hagiwara A, Inoue Y, et Al: *Comparison of GH- and non-GH-producing pituitary adenomas: imaging characteristics and pathologic correlation.* **Radiology** 228: 533-538, 2003.

MACROADENOMA IPOFISARIO: diagnosi differenziale



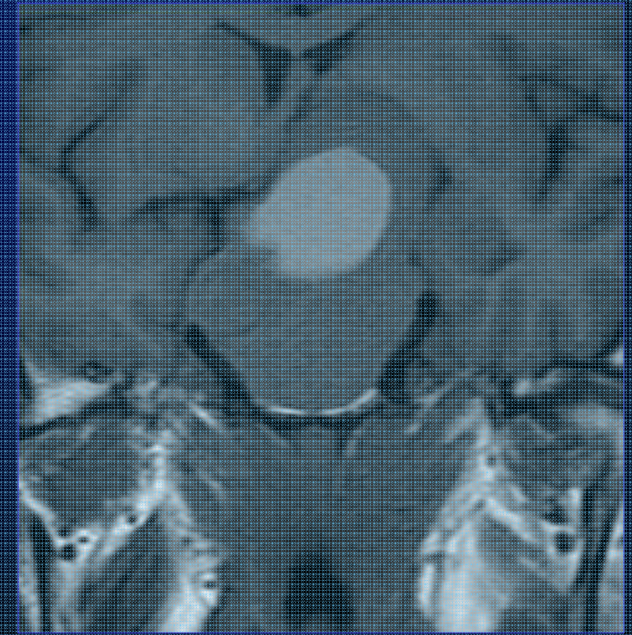
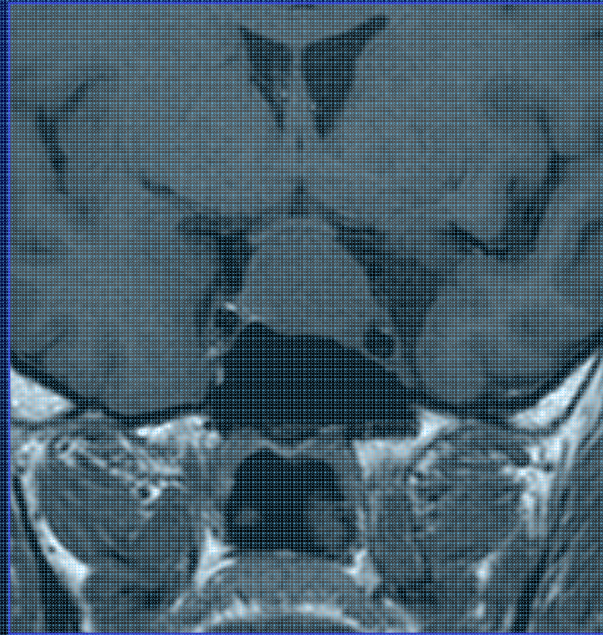
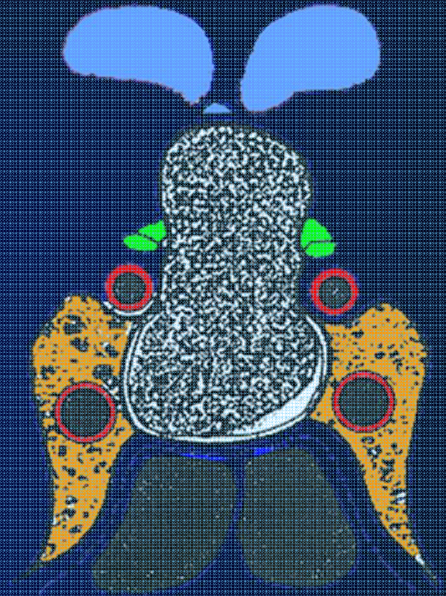
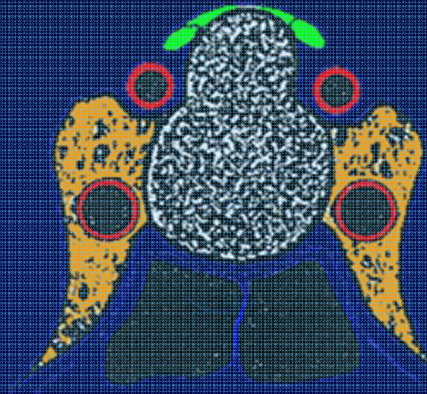
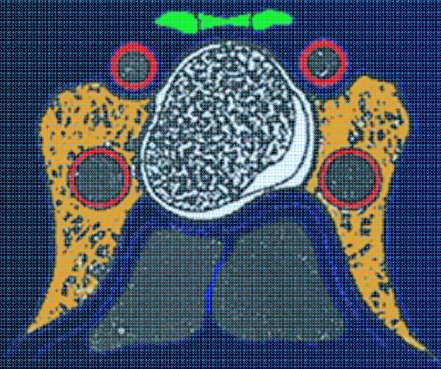
MACROADENOMA IPOFISARIO: diagnosi differenziale

MACROADENOMA DEL BASICRANIO

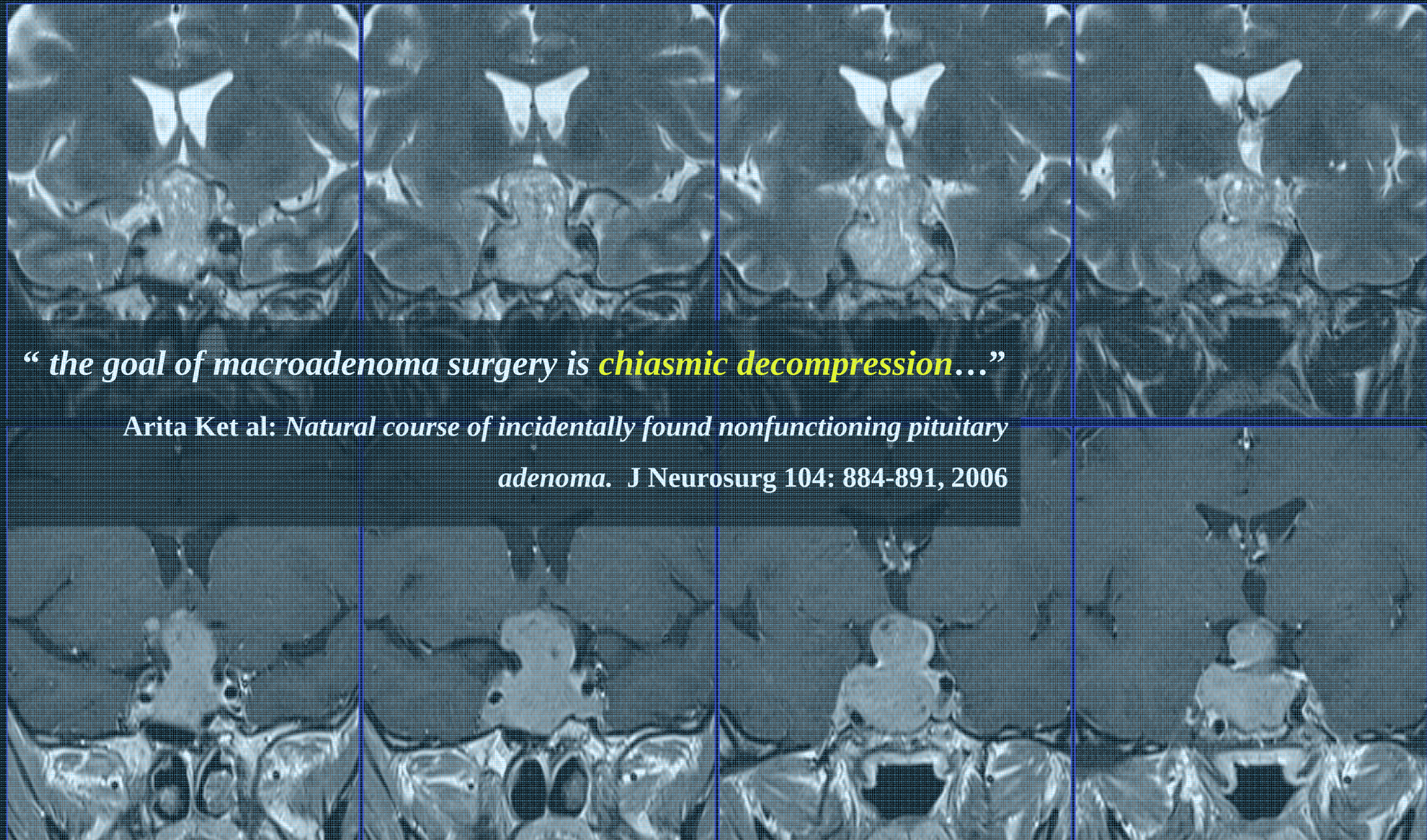


MACROADENOMA IPOFISARIO: bilancio spaziale

RAPPORTI CON IL CHIASMA



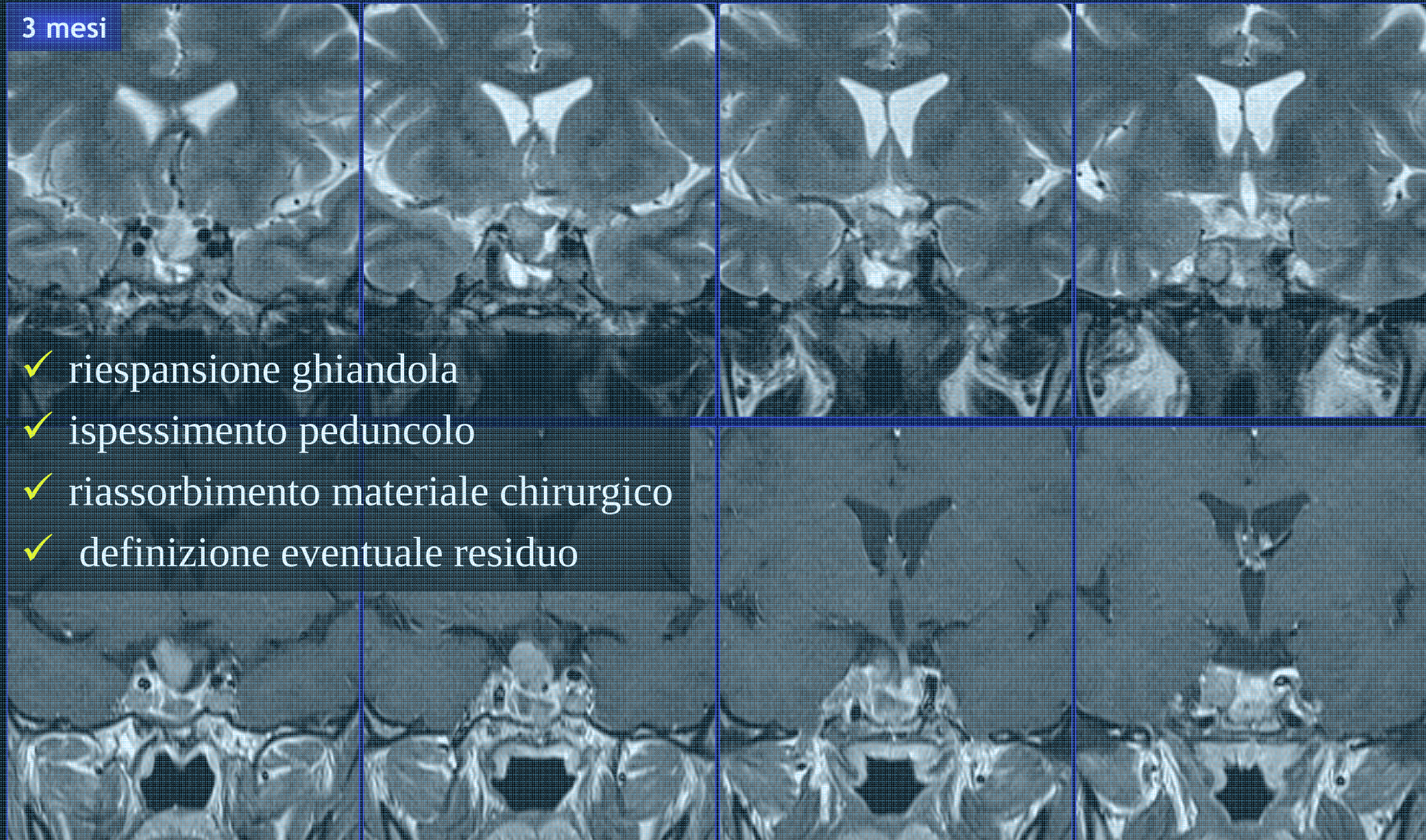
MACROADENOMA IPOFISARIO: controllo dopo terapia



MACROADENOMA IPOFISARIO: controllo dopo terapia

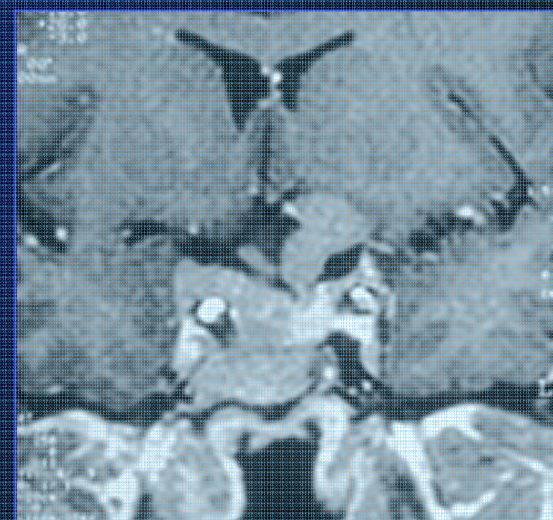
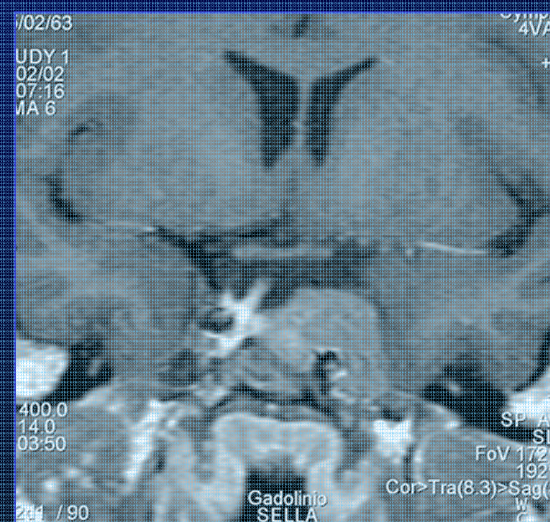
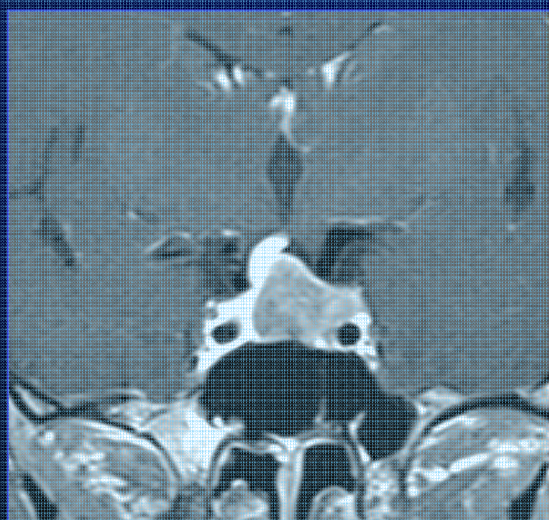
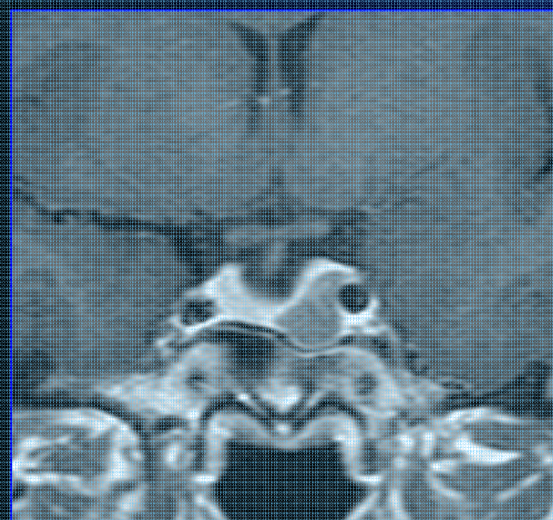
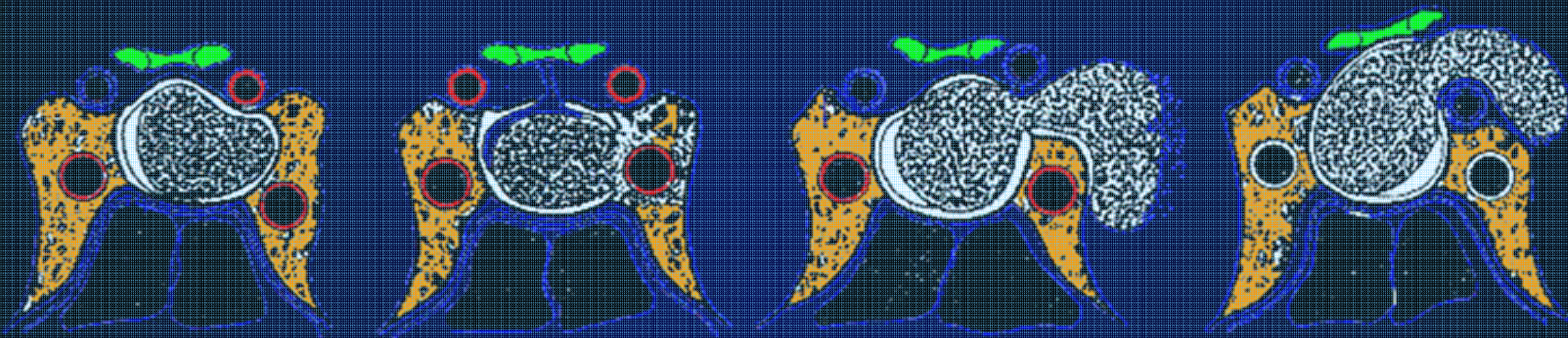
3 mesi

- ✓ riespansione ghiandola
- ✓ ispessimento peduncolo
- ✓ riassorbimento materiale chirurgico
- ✓ definizione eventuale residuo



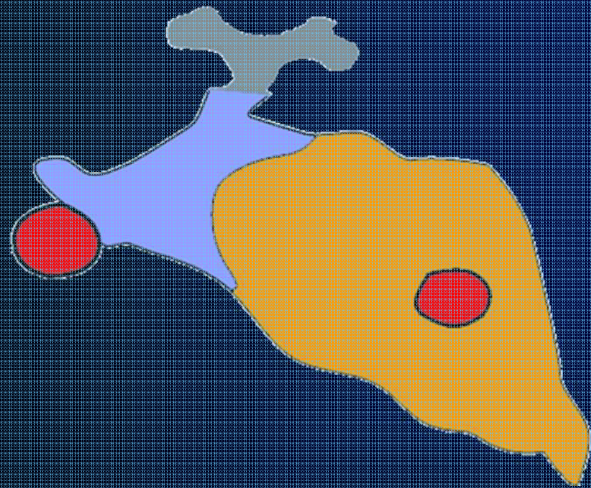
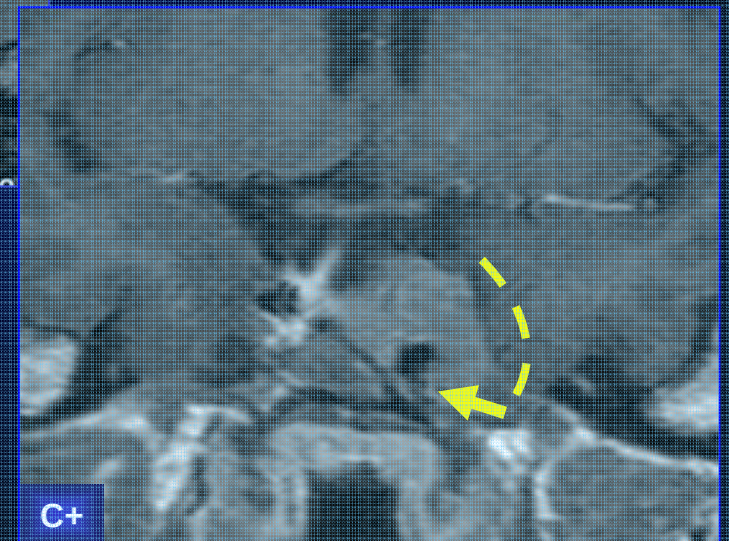
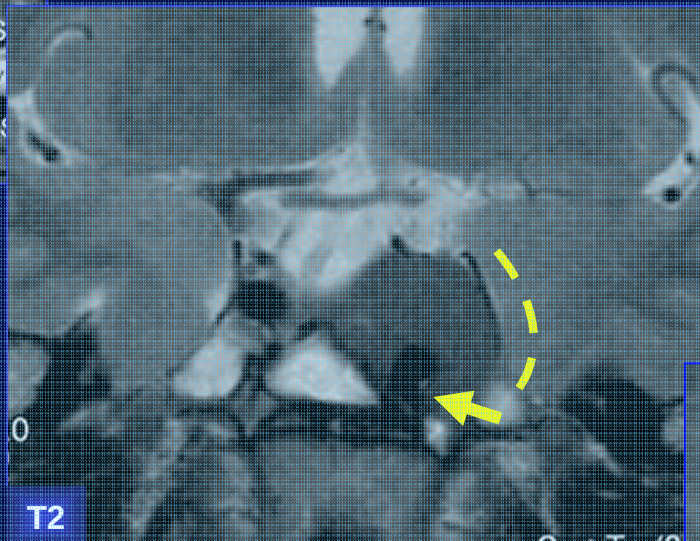
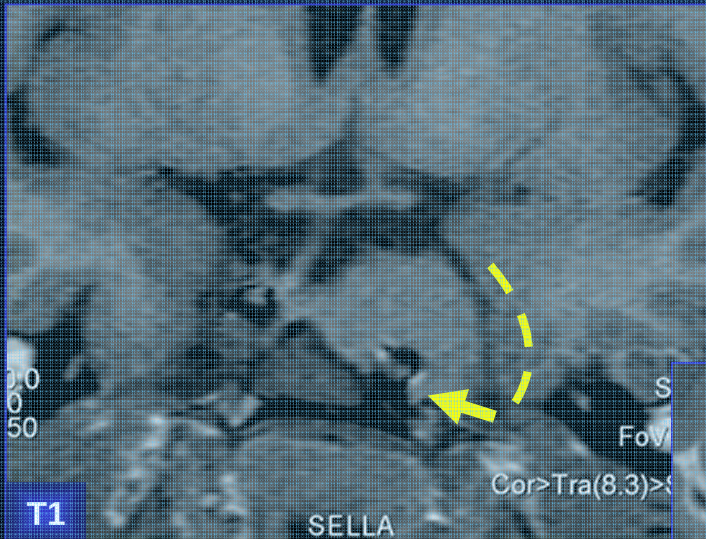
MACROADENOMA IPOFISARIO: bilancio spaziale

RAPPORTI CON IL SENO CAVERNOSO



MACROADENOMA IPOFISARIO: bilancio spaziale

RAPPORTI CON IL SENO CAVERNOSO

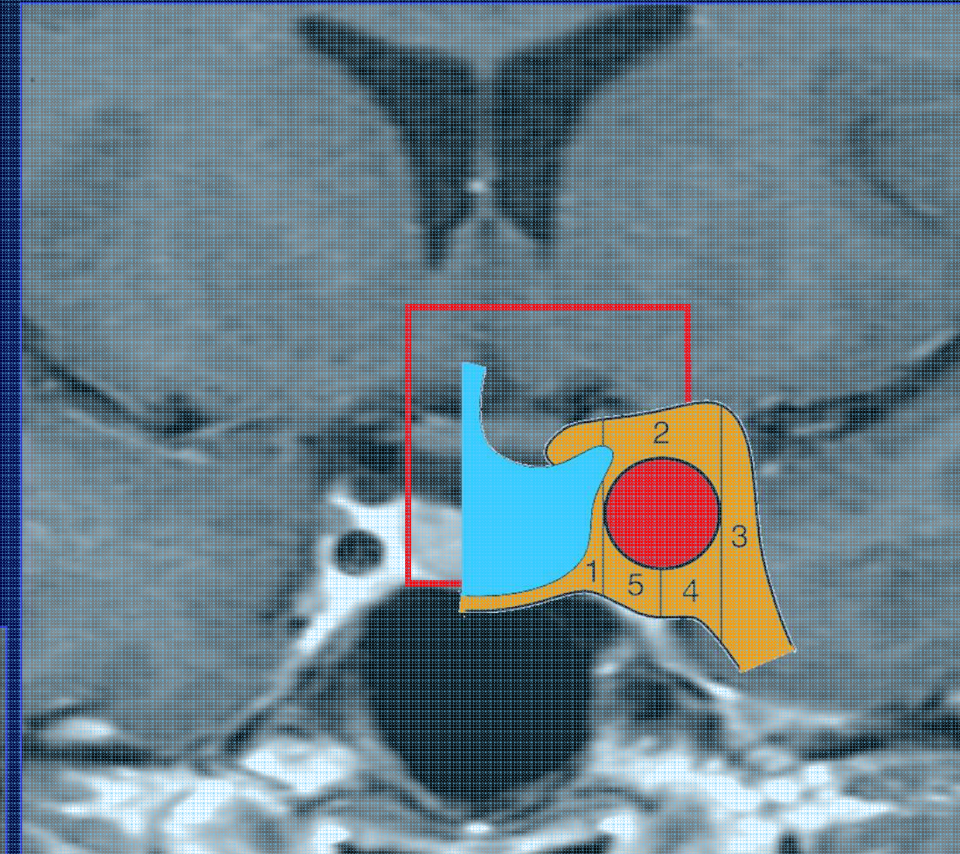


Cottier JP, Destrieux C, et Al:
Cavernous sinus invasion by pituitary adenoma: MR Imaging.
Radiology 215: 463-469, 2000.

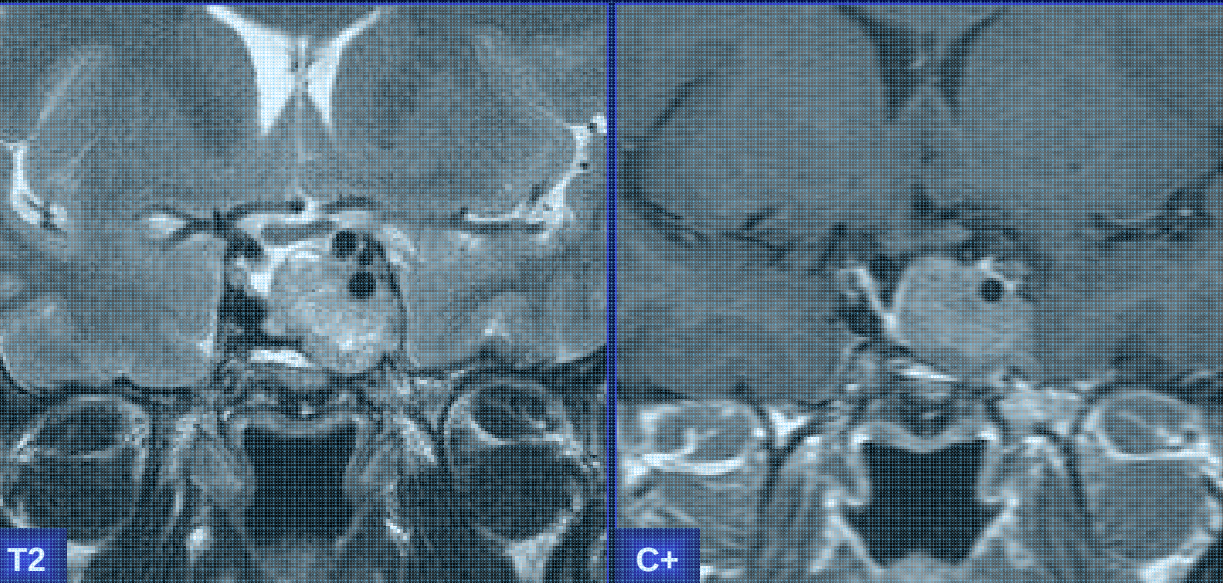
MACROADENOMA IPOFISARIO: bilancio spaziale

RAPPORTI CON IL SENO CAVERNOSO

- ✓ **mediale**
- ✓ **superiore**
- ✓ **laterale**
- ✓ **infero-laterale**
- ✓ **solco carotideo**



Cottier JP, Destrieux C, et Al: *Cavernous sinus invasion by pituitary adenoma: MR Imaging.*
Radiology 215: 463-469, 2000.



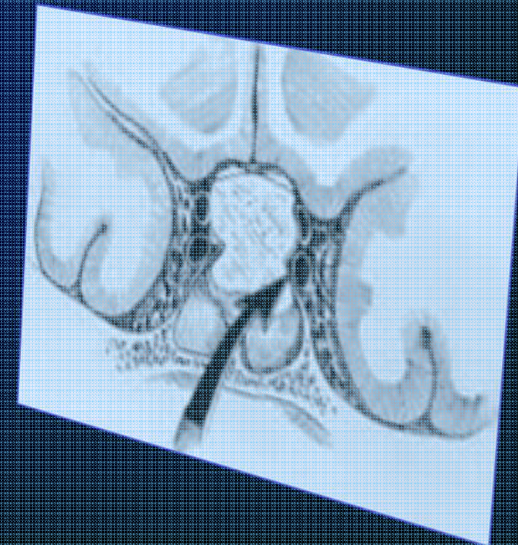
MACROADENOMA IPOFISARIO: controllo dopo terapia



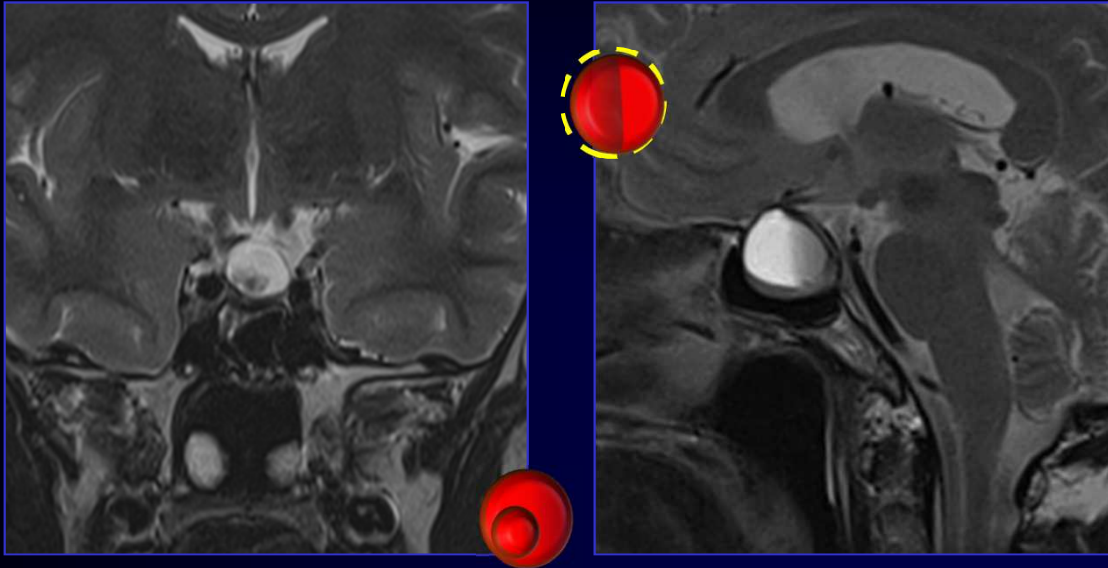
**Recidiva di
macroadenoma
intra e para-
sellare GH-
secernente**

**Profuso sanguinamento
intraoperatorio con
formazione di
pseudoaneurisma**

**Controllo intraoperatorio
temporaneo attraverso
tamponamento endosellare**



MALATTIA DI CUSHING



SENSIBILITA' 100 %

1.5 T > 3 T

DOSAGGIO
GADOLINIO

SEQUENZE:
DINAMICHE
SPIN-ECHO,
SPGR o VI-SGE

TECNICA

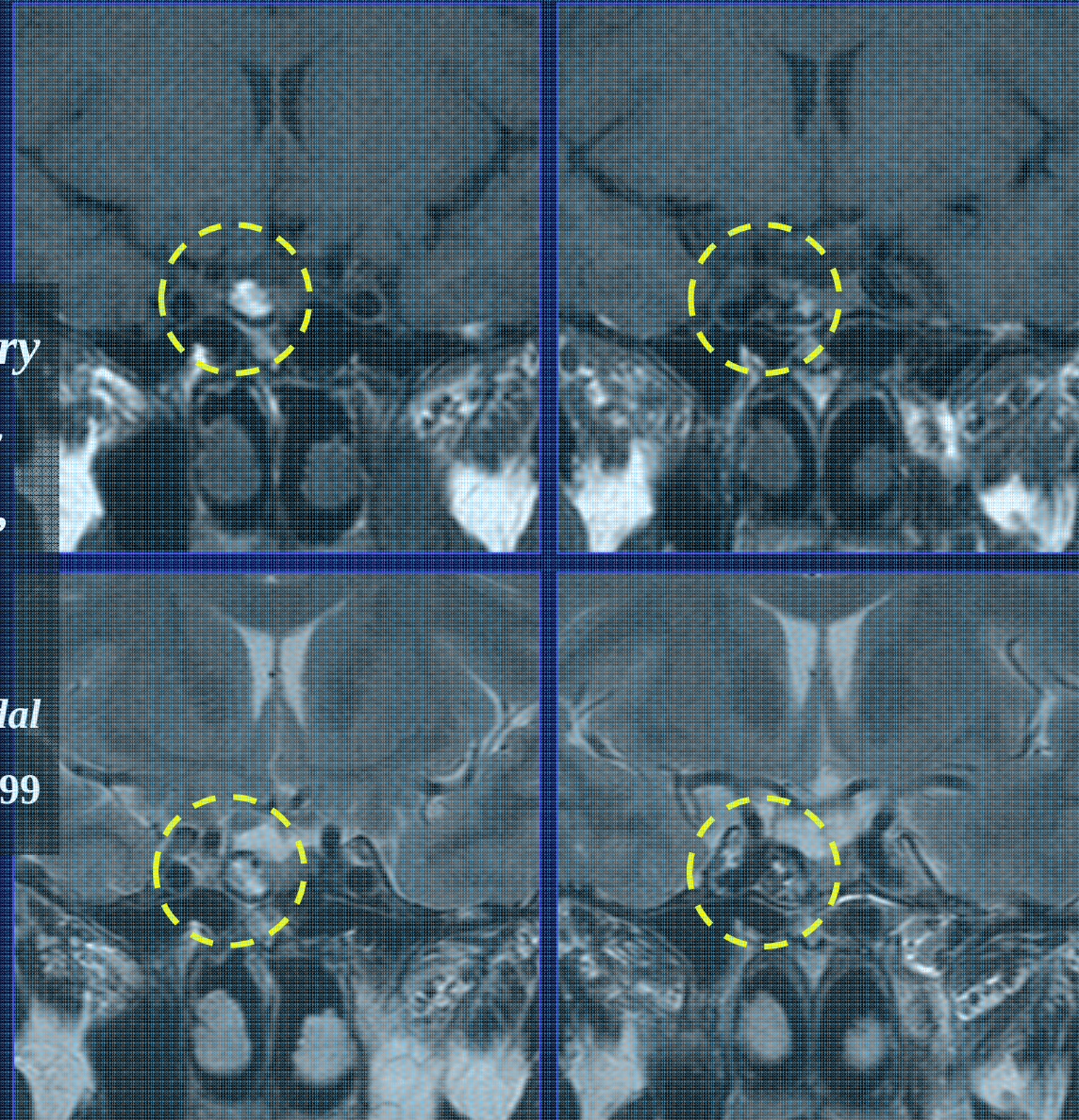
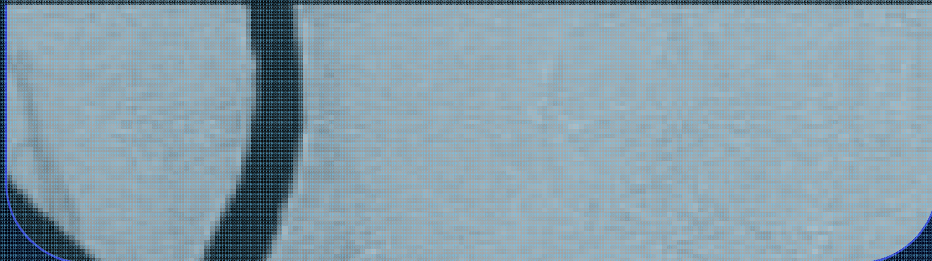
STRUTTURA

MACROADENOMA IPOFISARIO: controllo dopo terapia

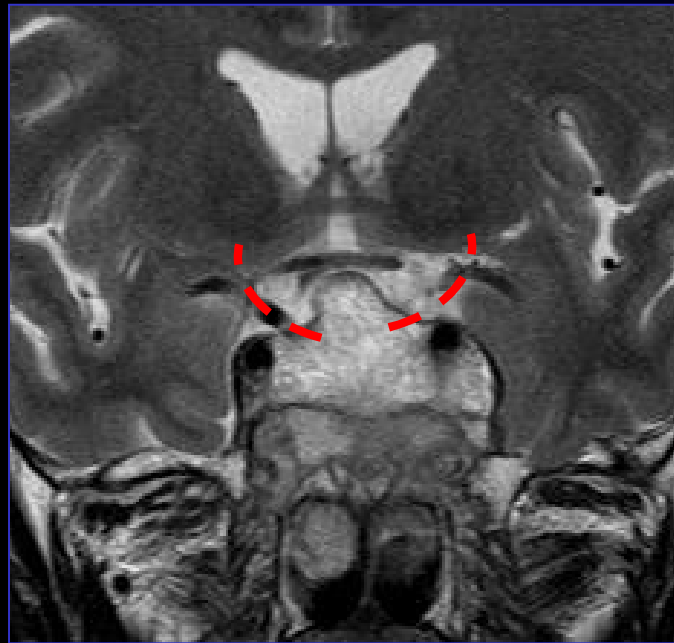


“virtually every direct injury to a carotid artery that is indirectly repaired during surgery results in a subsequent fals aneurysm...”

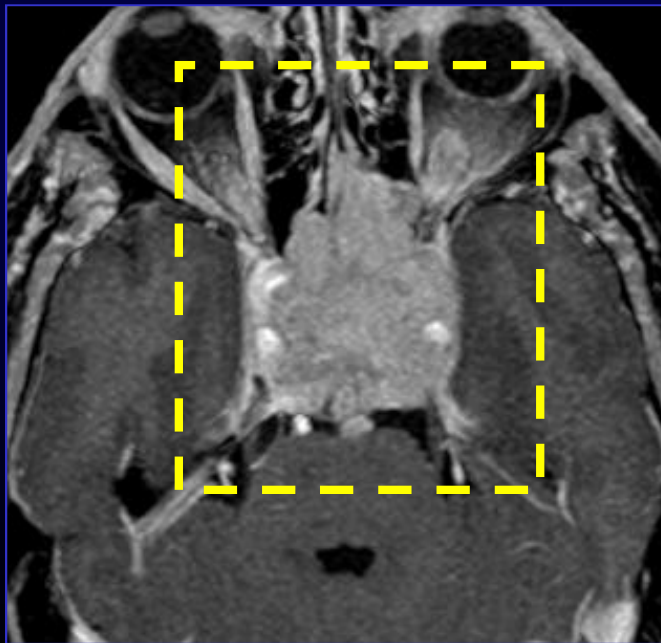
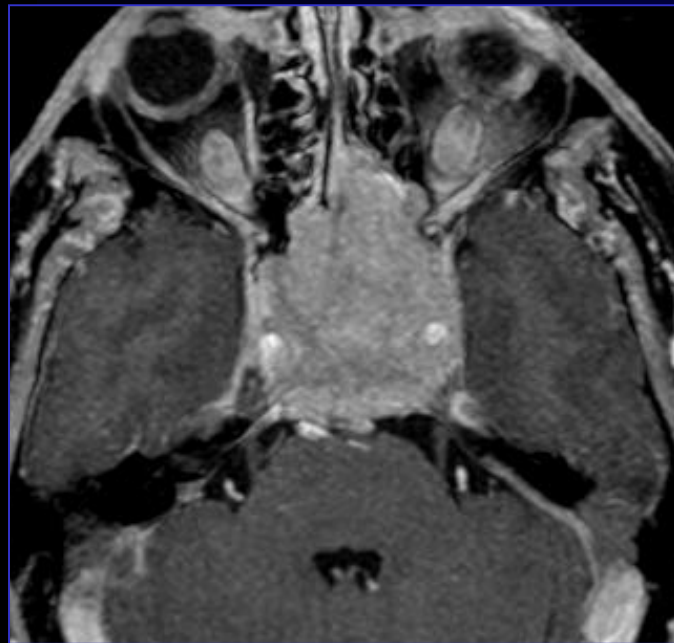
Laws ER: *Vascular complications of transsphenoidal surgery. Pituitary 2: 163-170, 1999*



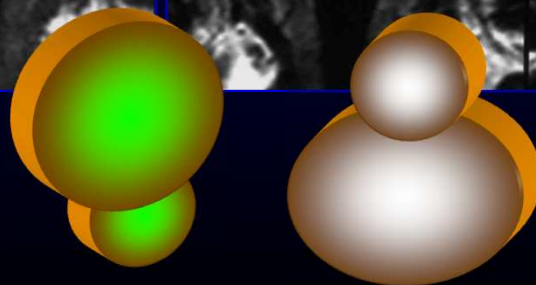
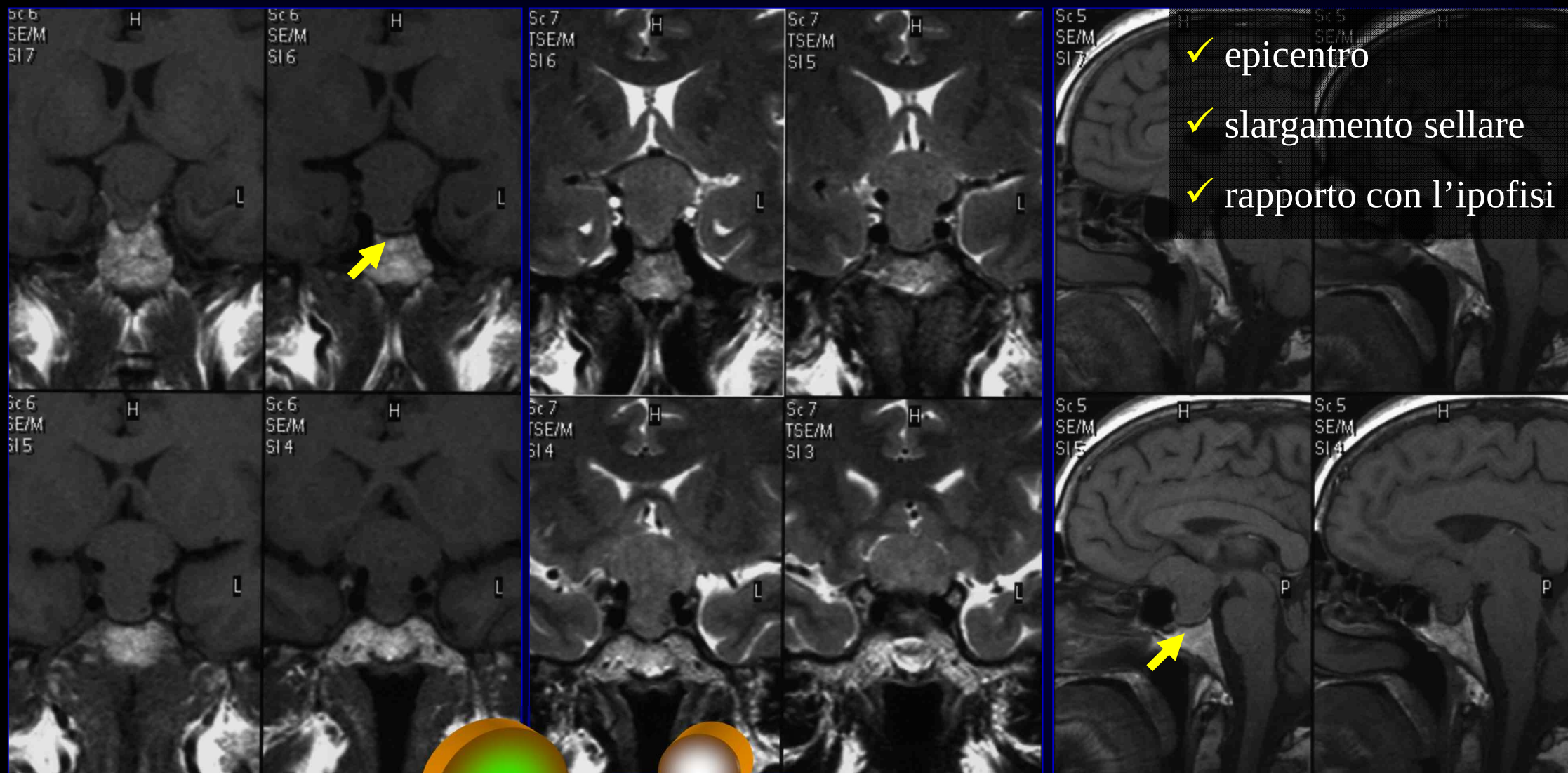
MACROADENOMA IPOFISARIO



- ✓ DIAGNOSI DIFFERENZIALE
- ✓ DEFINIZIONE STRUTTURA
- ✓ BILANCIO SPAZIALE
- ✓ CONTROLLO DOPO TERAPIA



1) MACROADENOMA IPOFISARIO: diagnosi differenziale



“champagne cork”

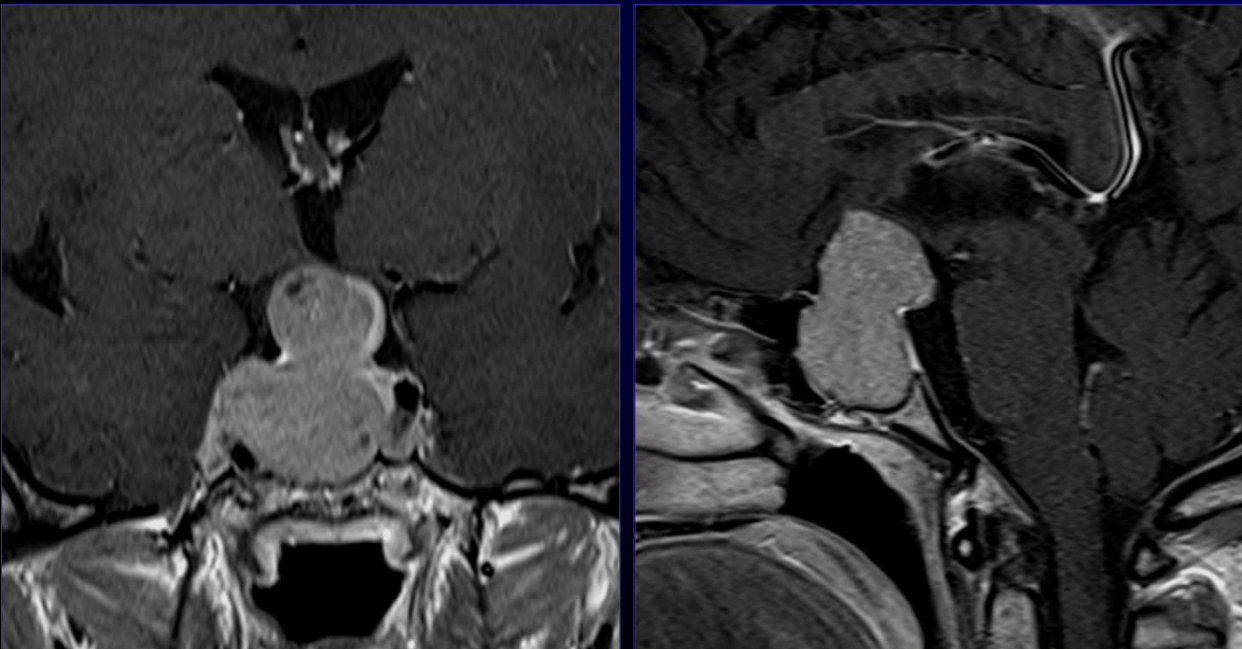
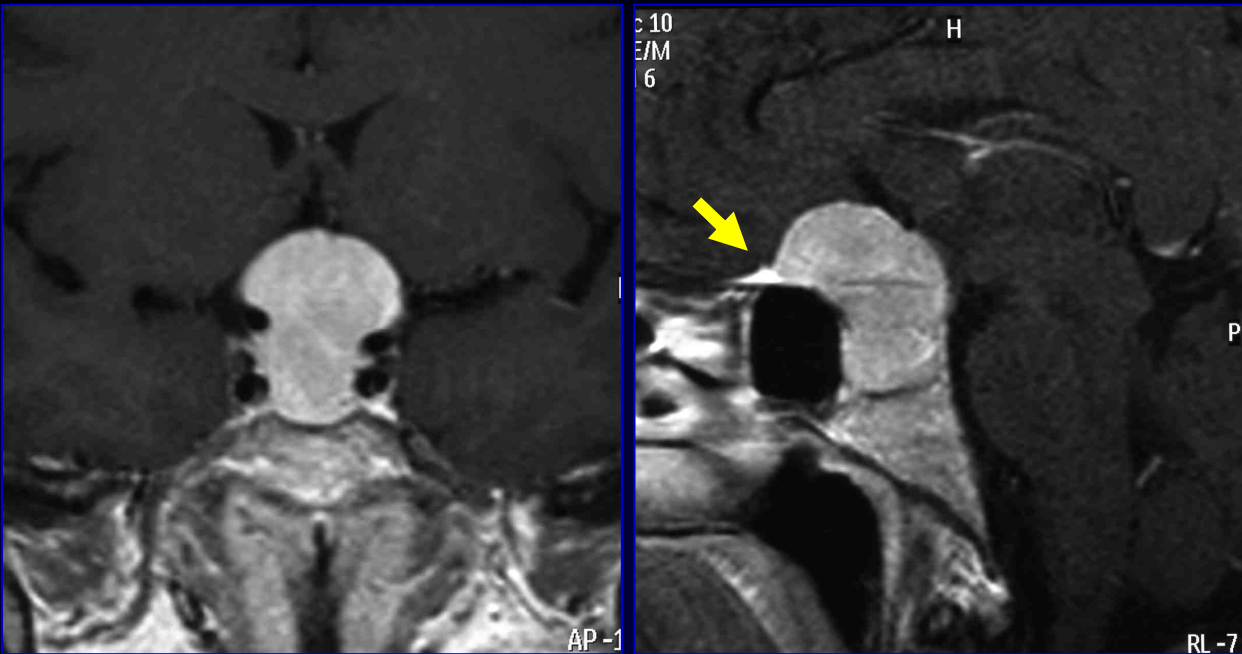
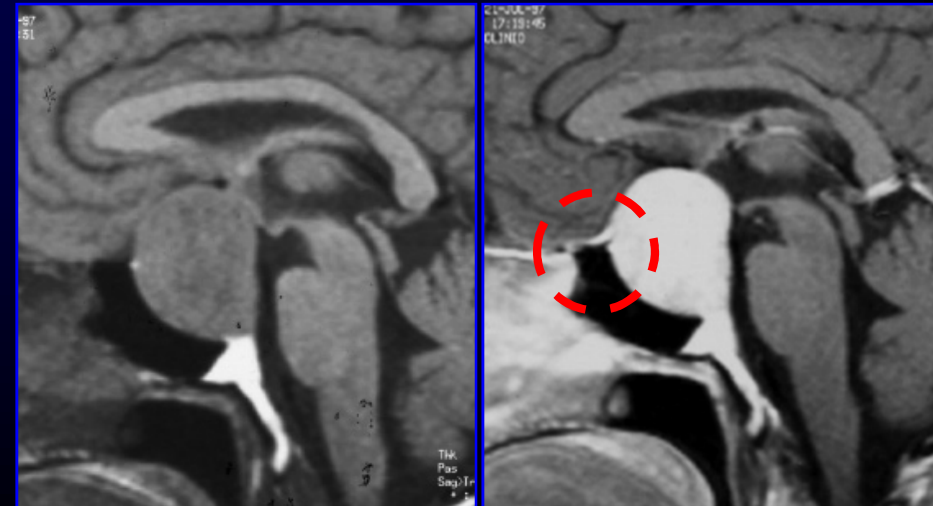
1) MACROADENOMA IPOFISARIO: diagnosi differenziale

MENINGIOMA

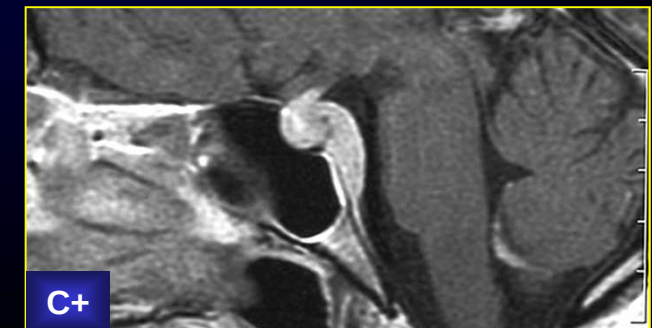
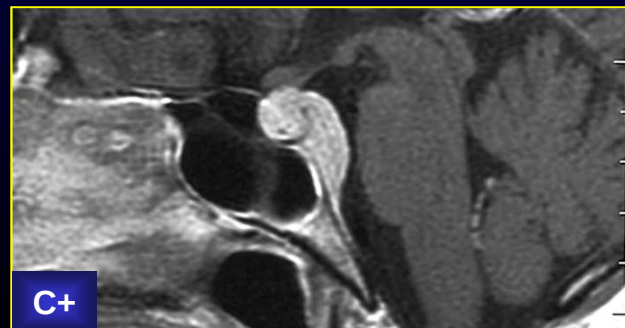
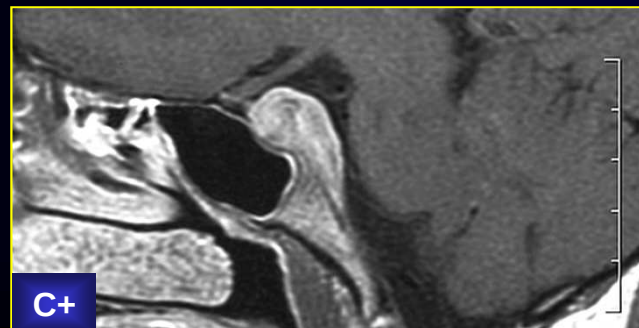
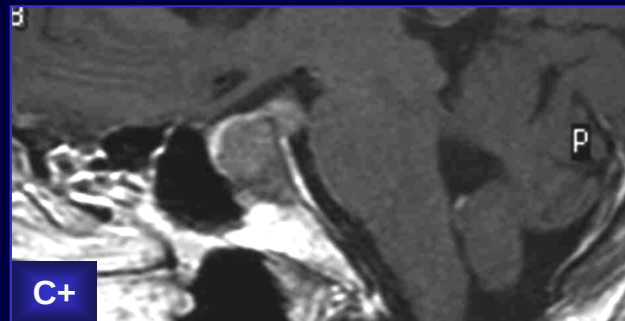
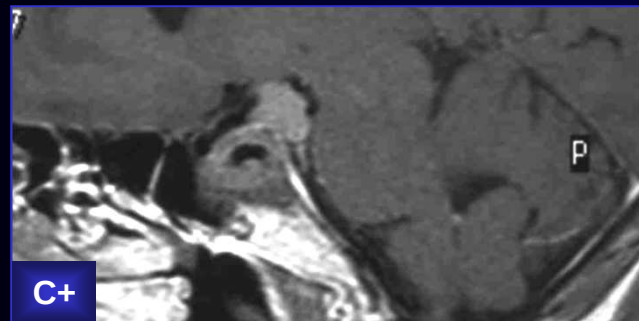
- ✓ impregnazione
- ✓ reazione durale



MACROADENOMA

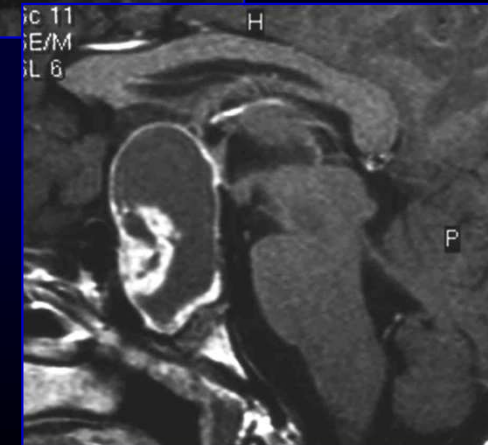
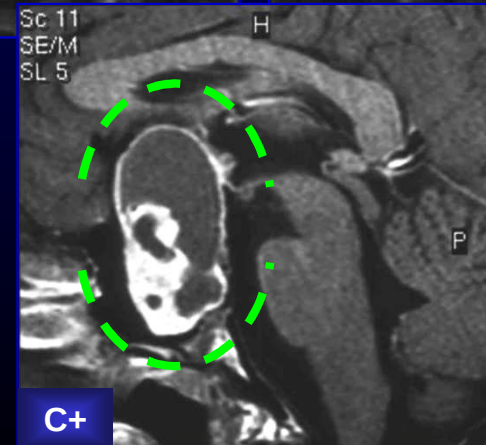
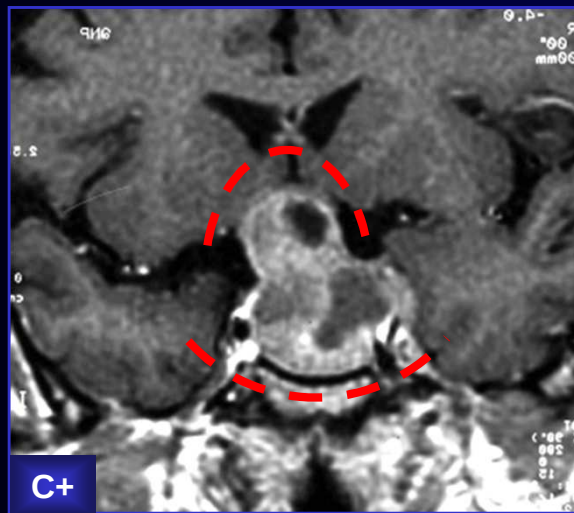
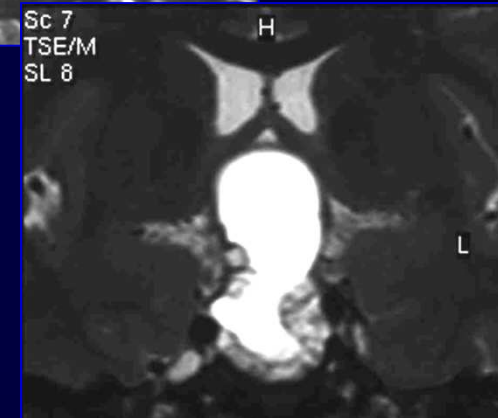
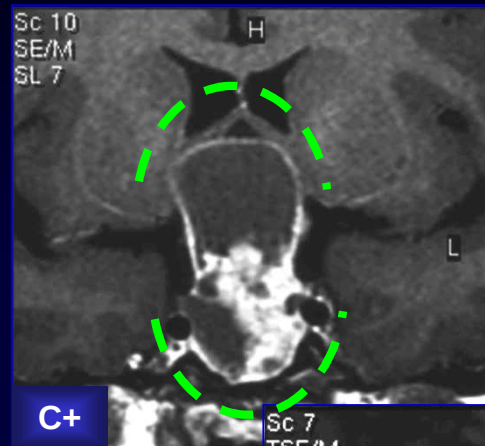
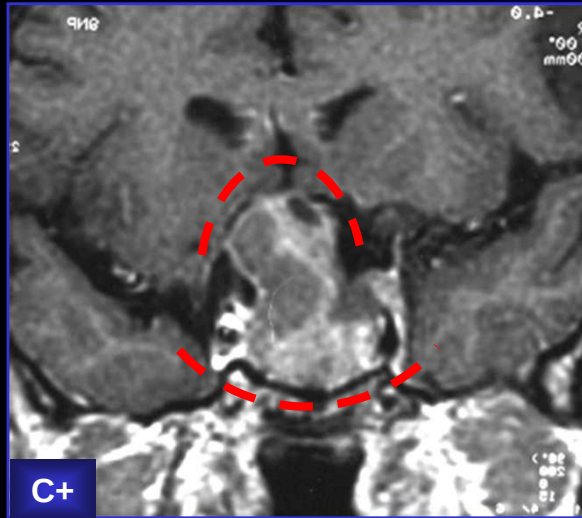


1) MACROADENOMA IPOFISARIO: diagnosi differenziale



1) MACROADENOMA IPOFISARIO: diagnosi differenziale

MACROADENOMA

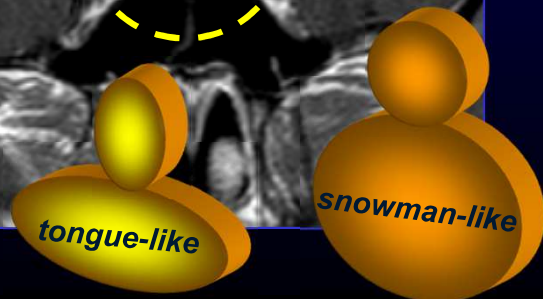
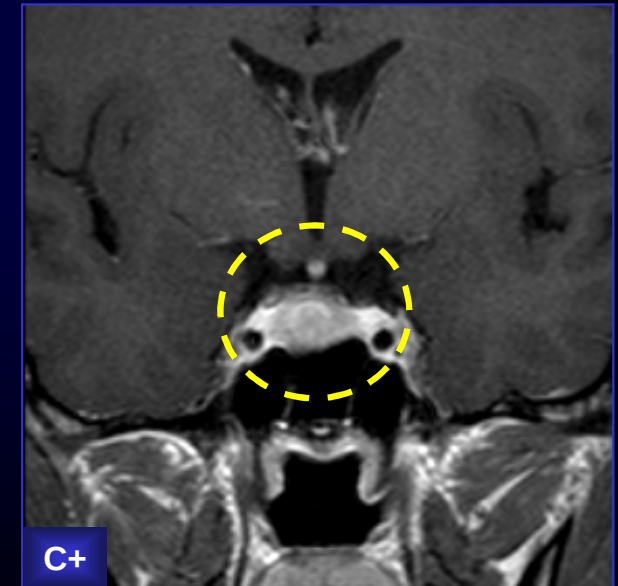
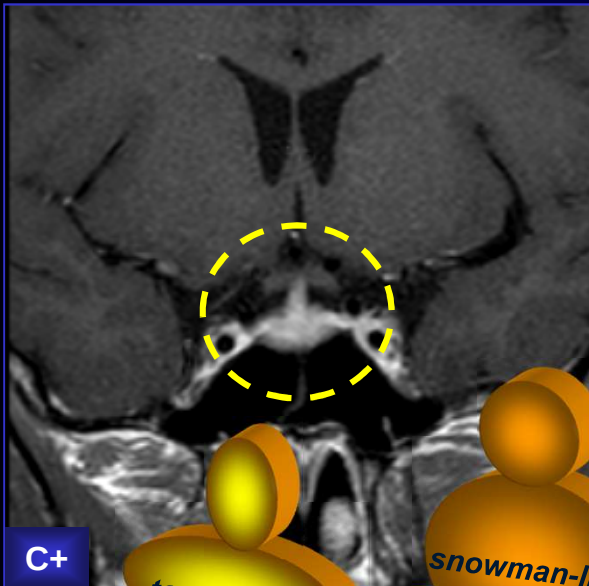
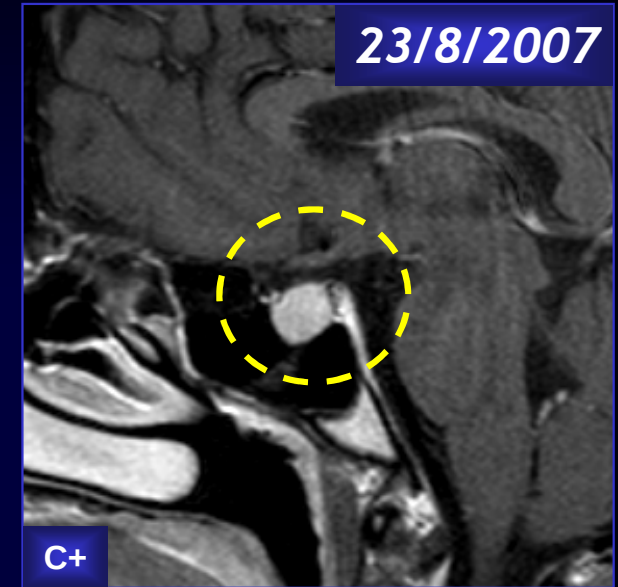
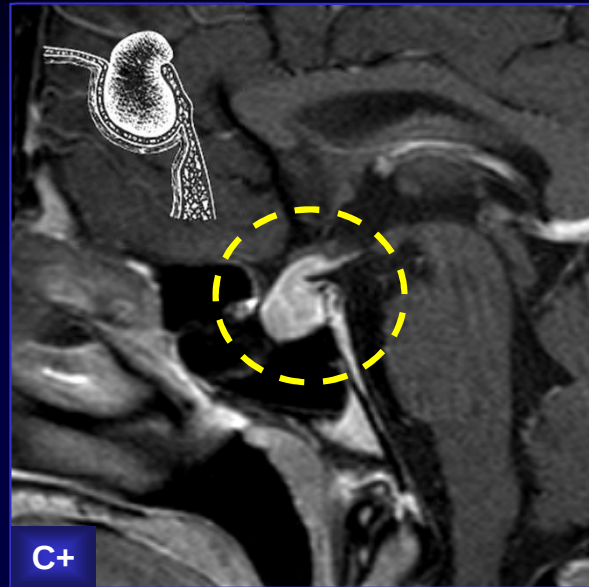


CRANIOFARINGIOMA

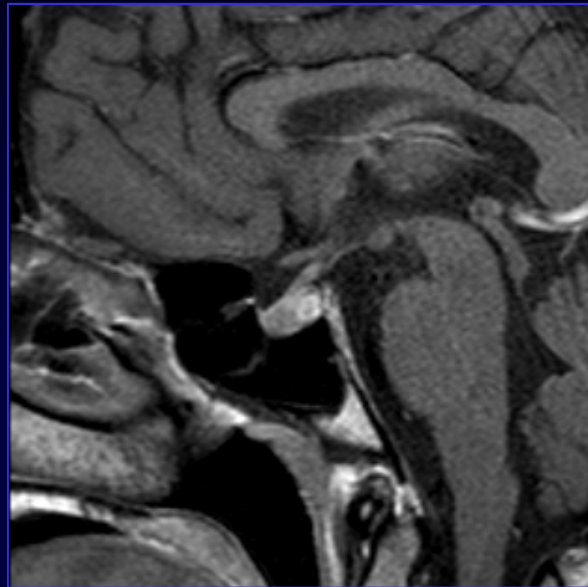
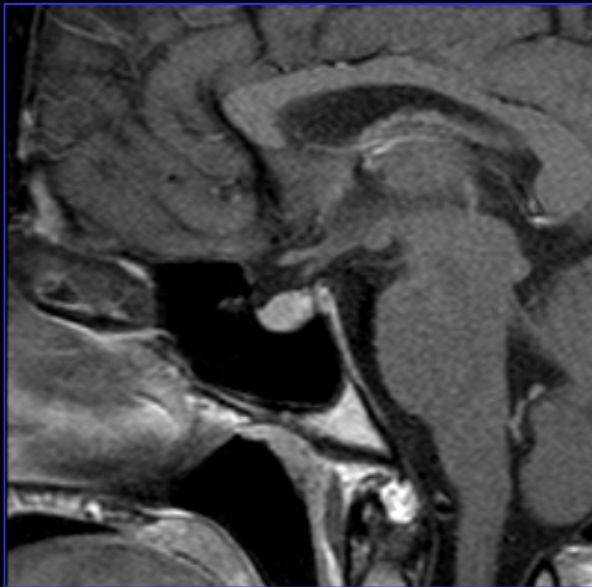
✓ esordio acuto 1) **MACROADENOMA IPOFISARIO: diagnosi differenziale**

✓ diabete insipido

✓ ipopituitarismo



1) MACROADENOMA IPOFISARIO: diagnosi differenziale

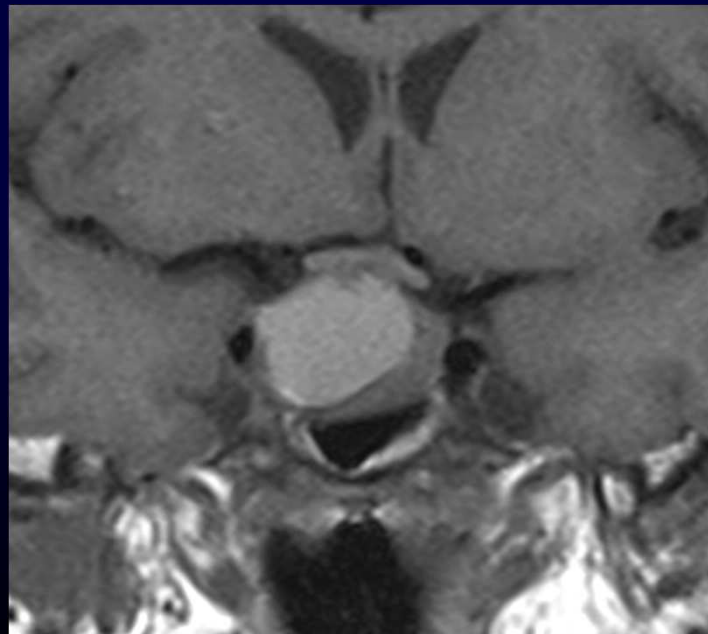
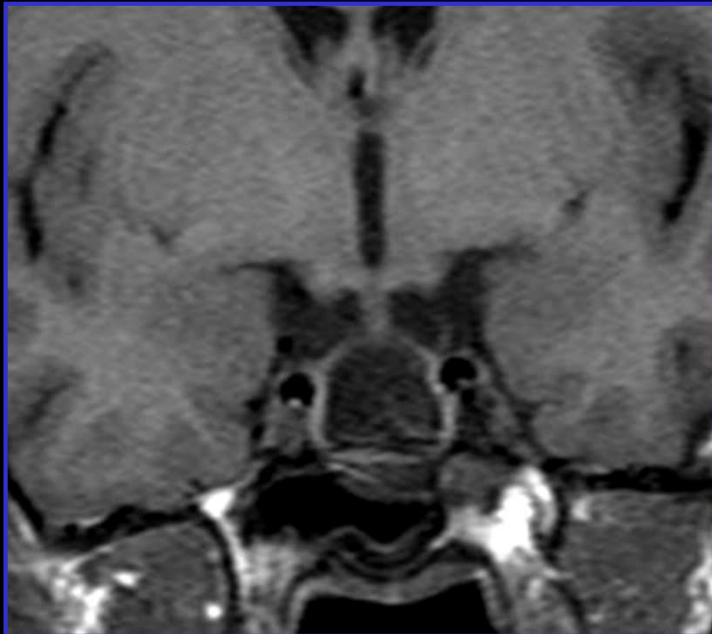
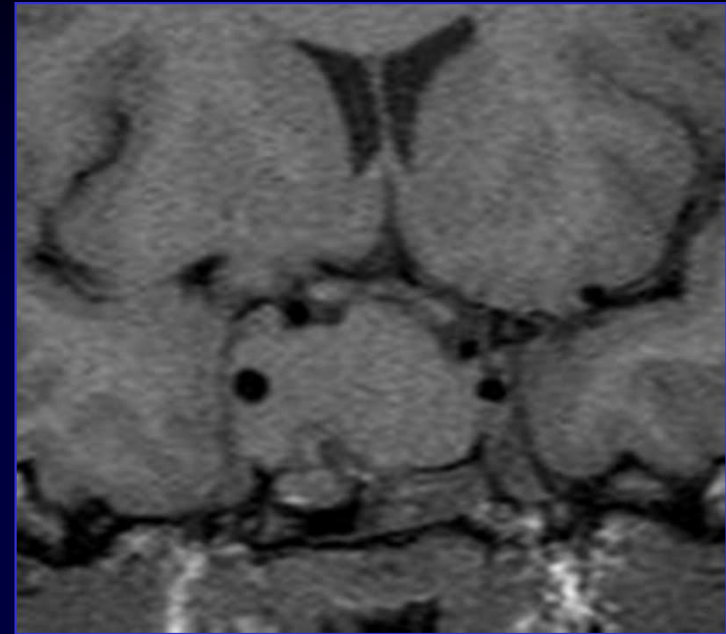
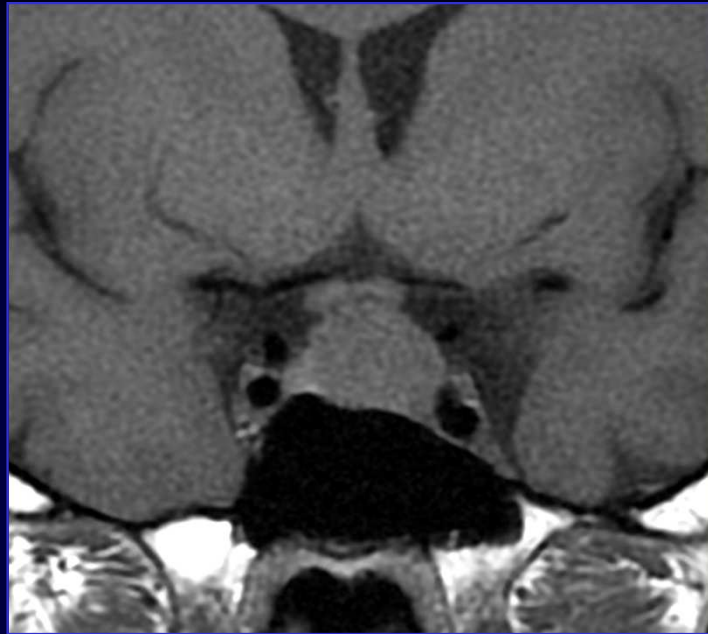
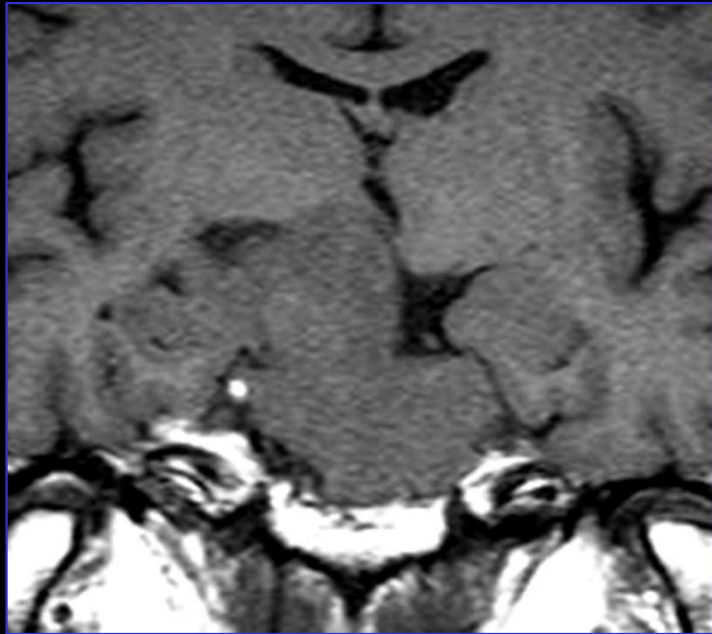


6/9/2007



T₁

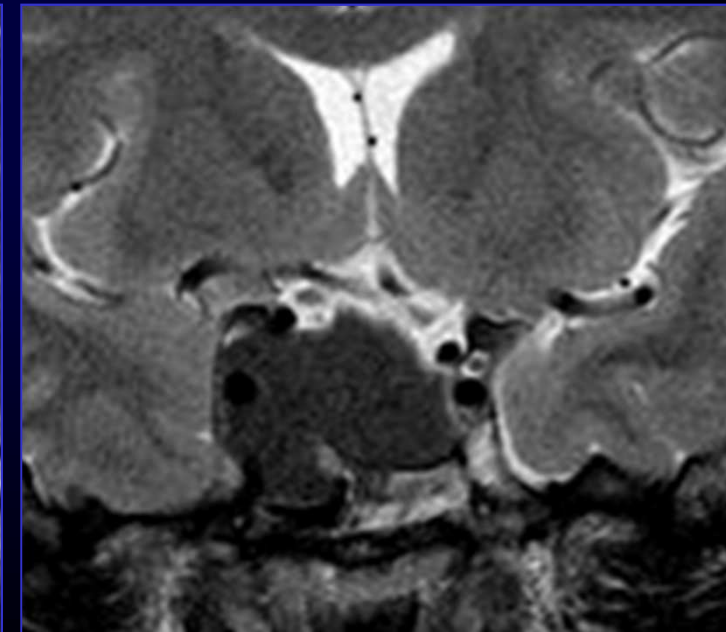
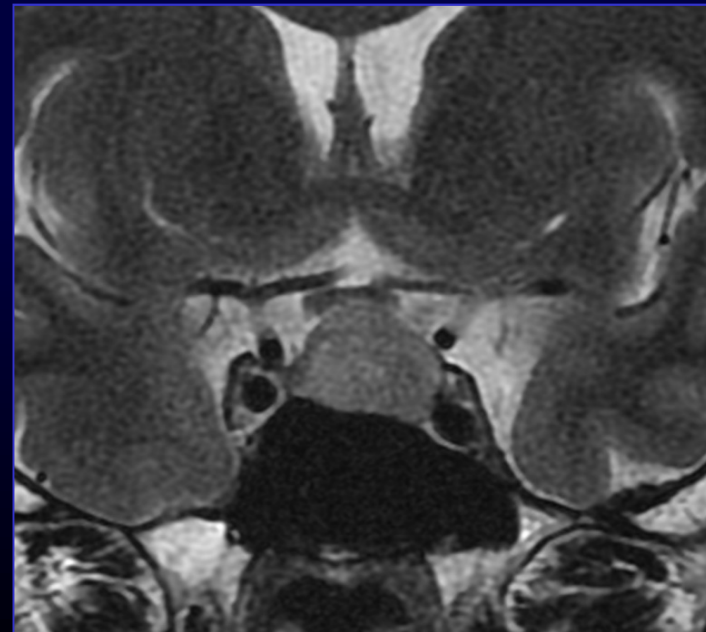
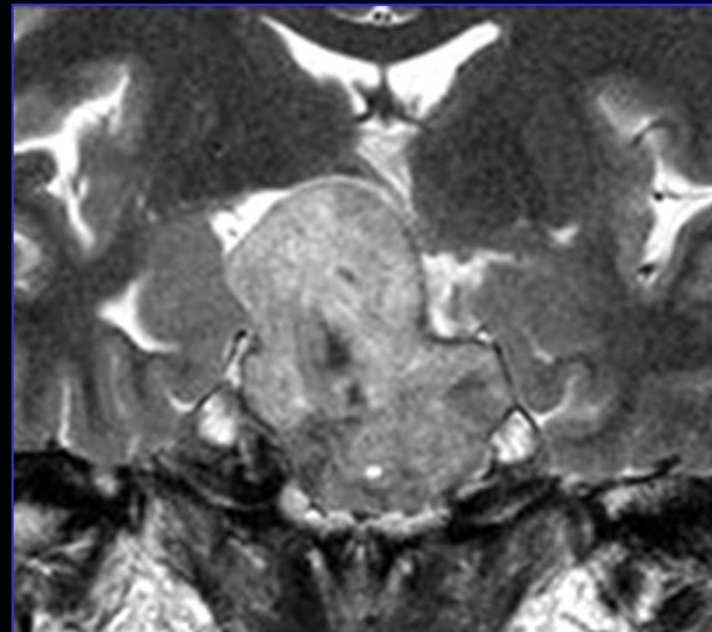
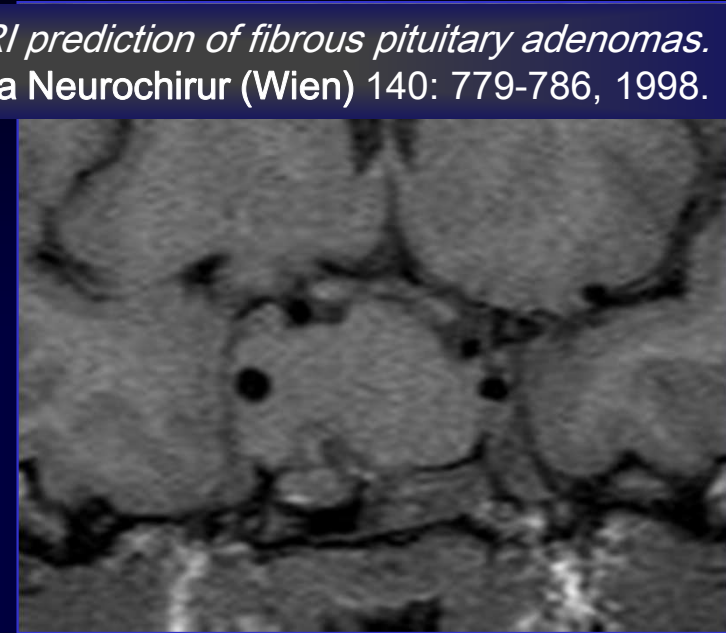
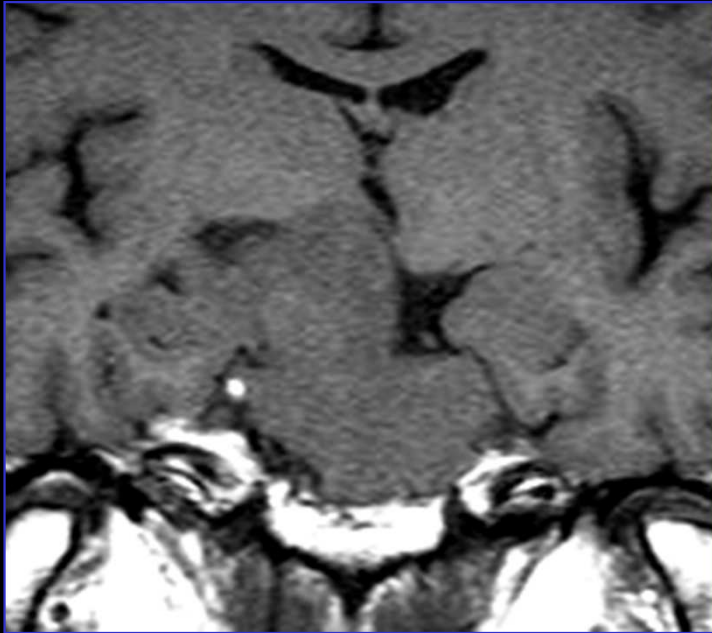
2) MACROADENOMA IPOFISARIO: definizione strutturale



T₂

2) MACROADENOMA IPOFISARIO: definizione strutturale

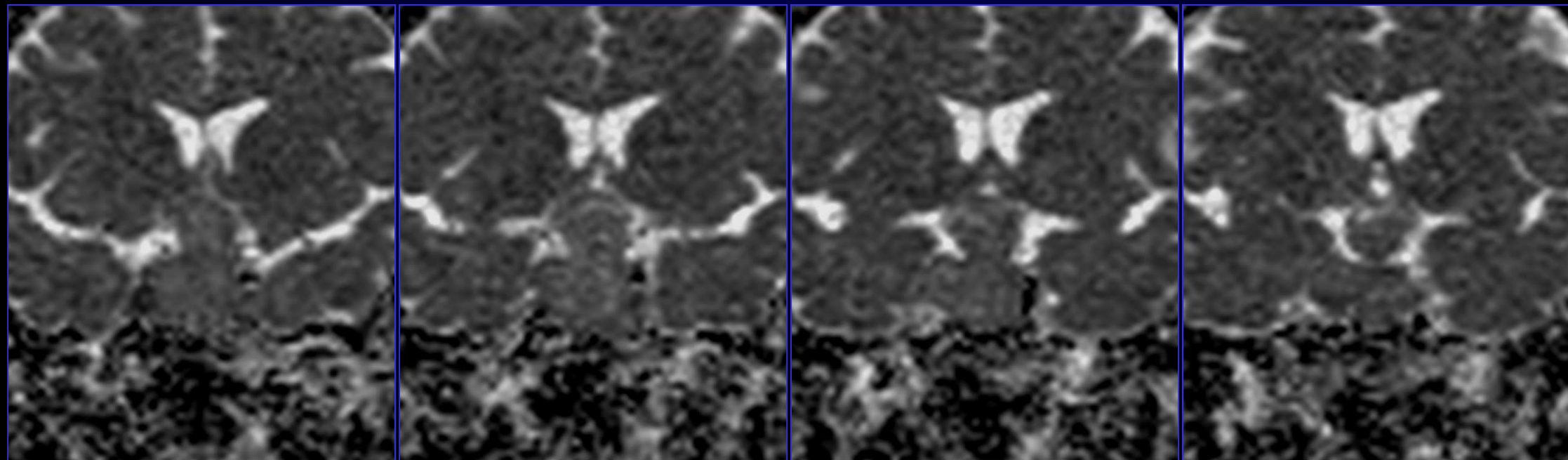
Iuchi T, Saeki N, et Al: *MRI prediction of fibrous pituitary adenomas.*
Acta Neurochirur (Wien) 140: 779-786, 1998.



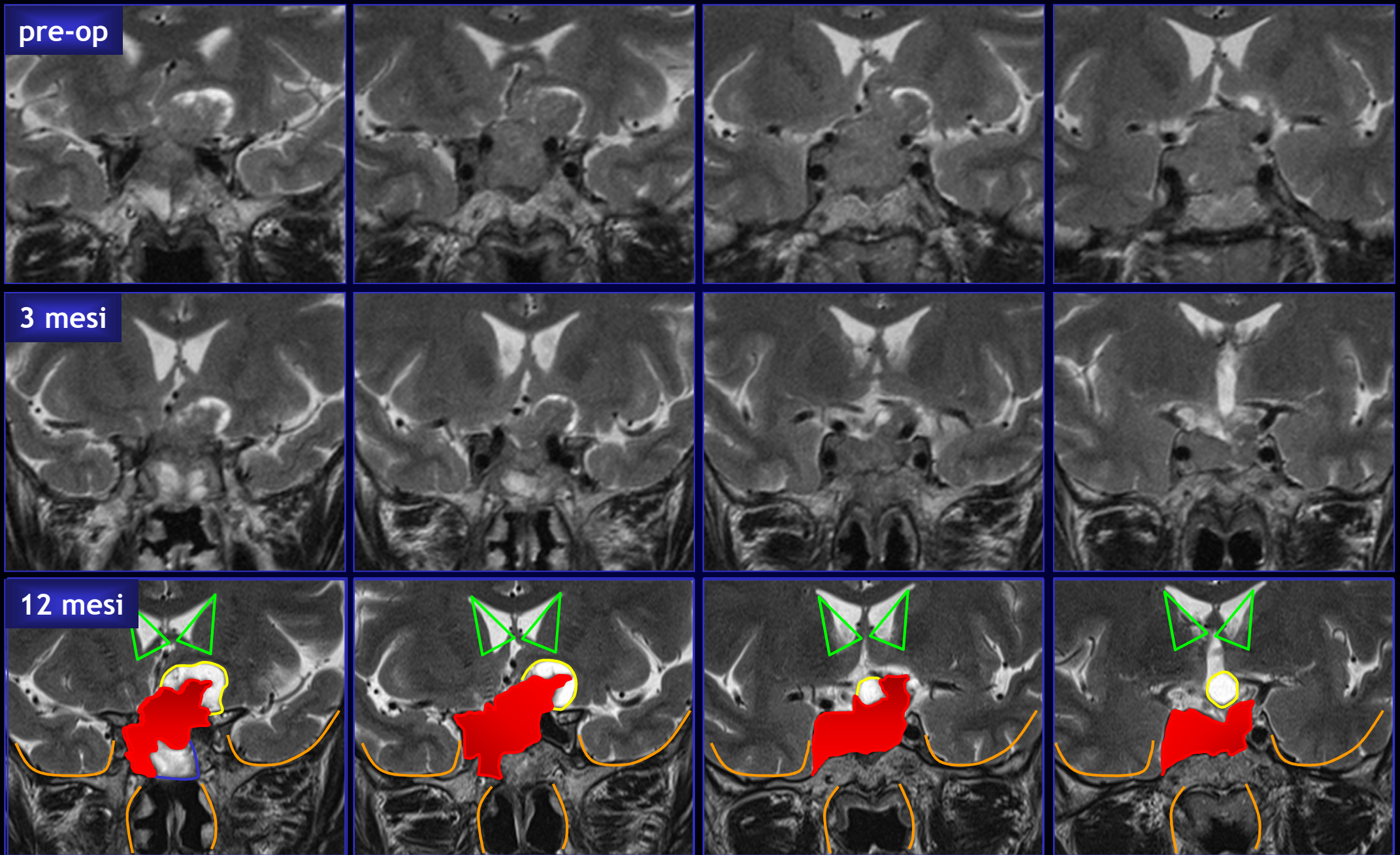
2) MACROADENOMA IPOFISARIO: definizione strutturale

*“... transsphenoidal hypophysectomy of tumors with restricted diffusion
(ADC ratio < 1.1) is more likely to fail...”*

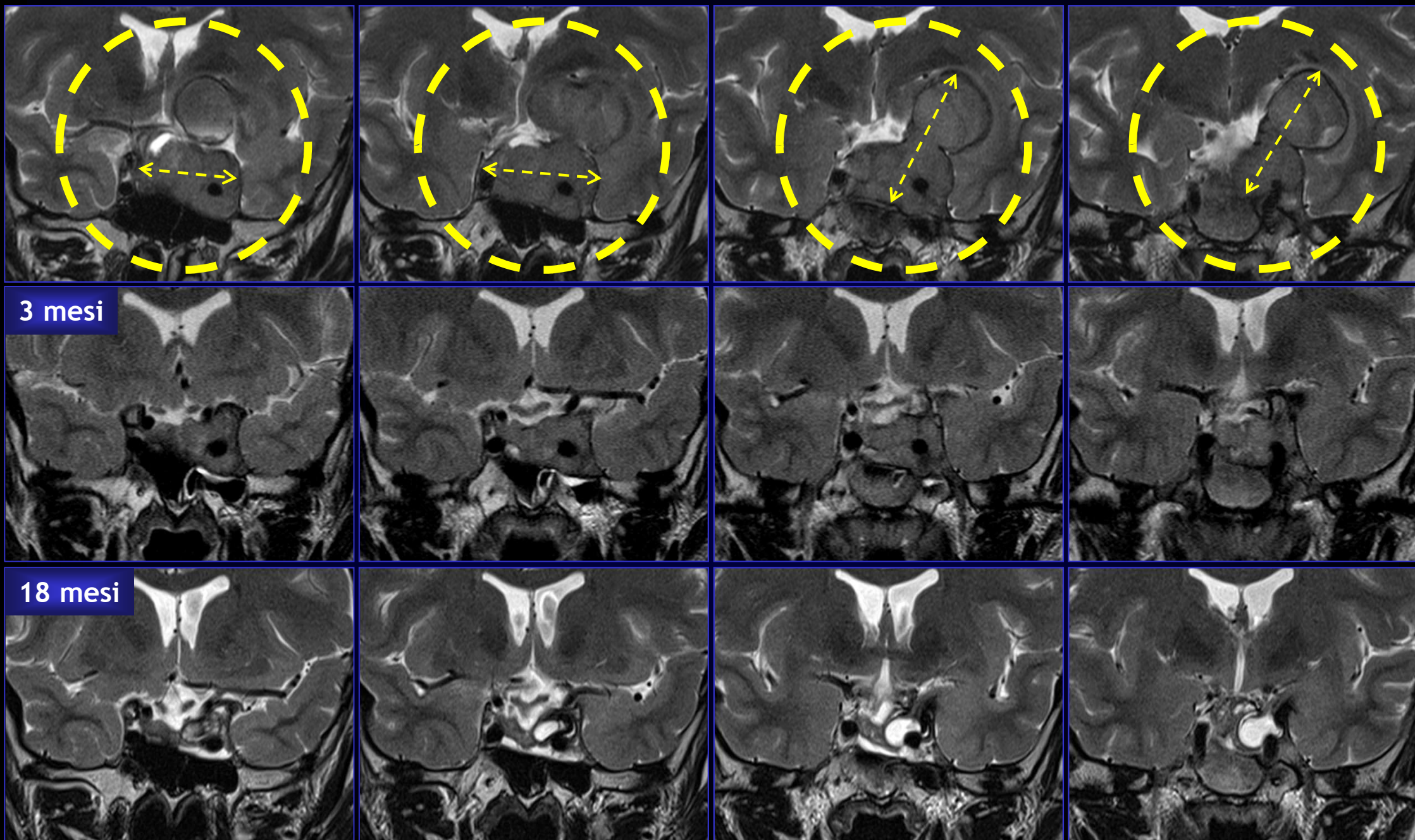
Boxerman JL et al: Preoperative MRI evaluation of pituitary macroadenoma: imaging features predictive of successful transsphenoidal surgery. AJR 195: 720-728, 2010



4) MACROADENOMA IPOFISARIO: controllo dopo terapia

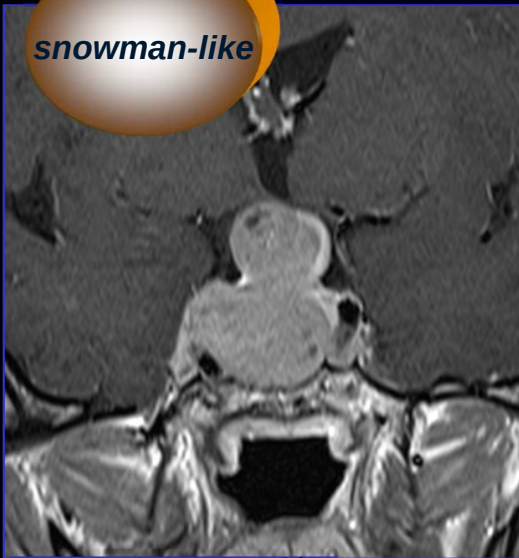


4) MACROADENOMA IPOFISARIO: controllo dopo terapia

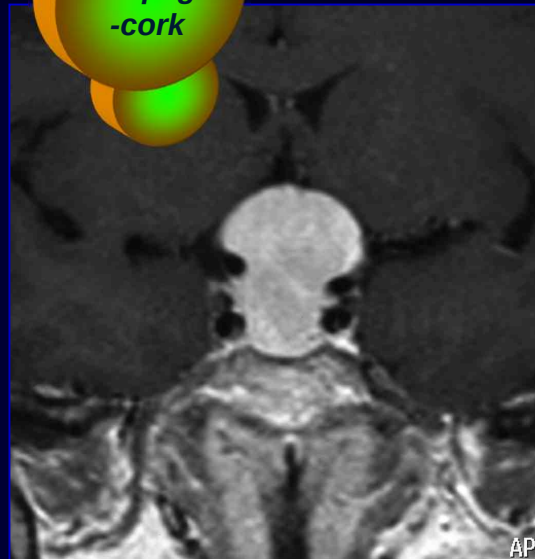


REGIONE SELLEARE

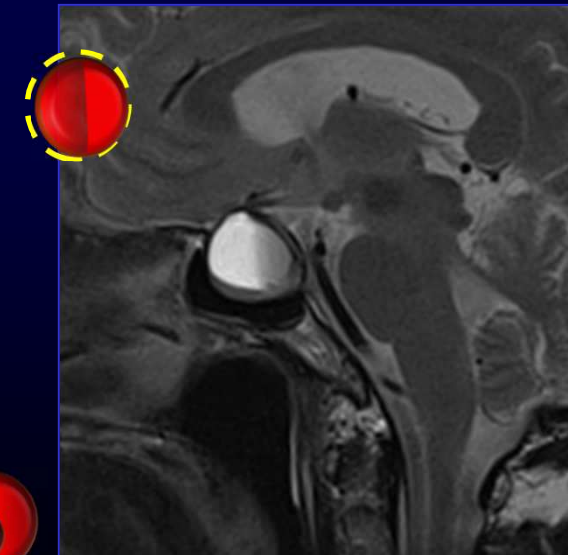
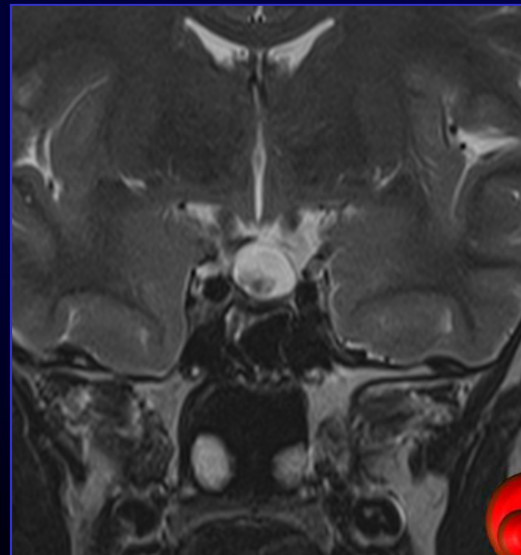
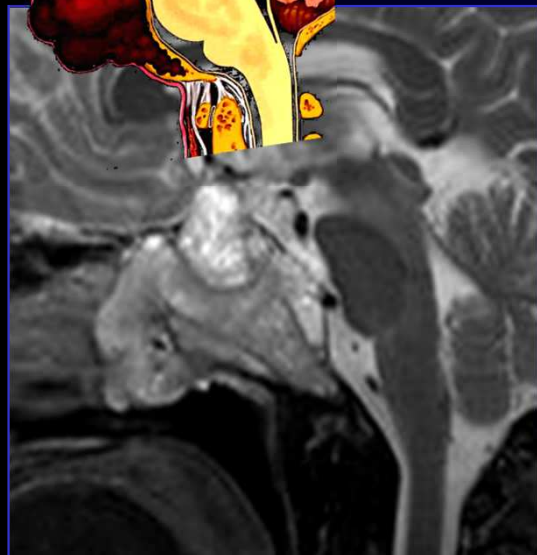
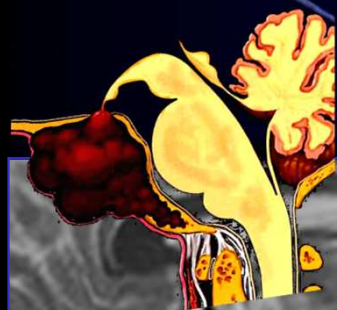
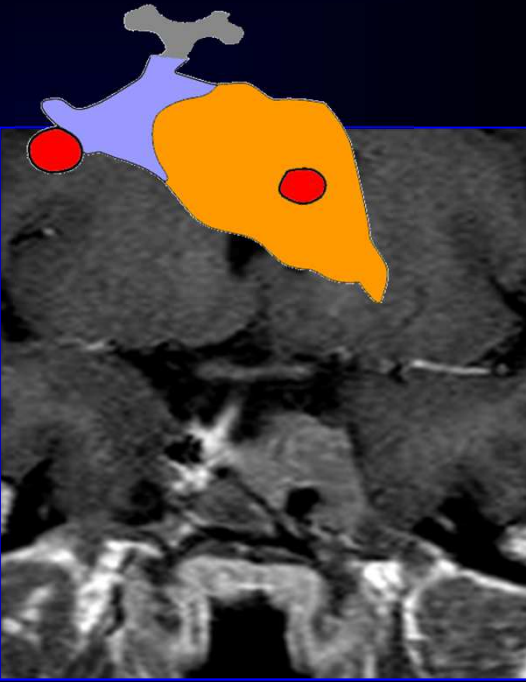
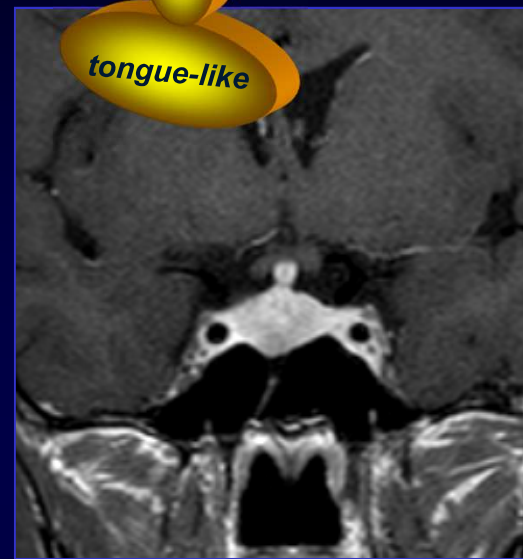
snowman-like



champagne-cork



tongue-like

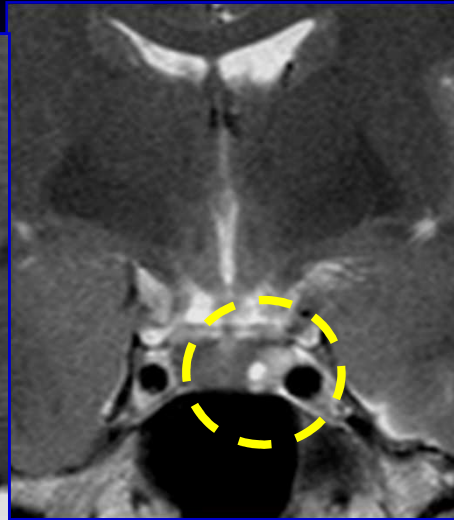
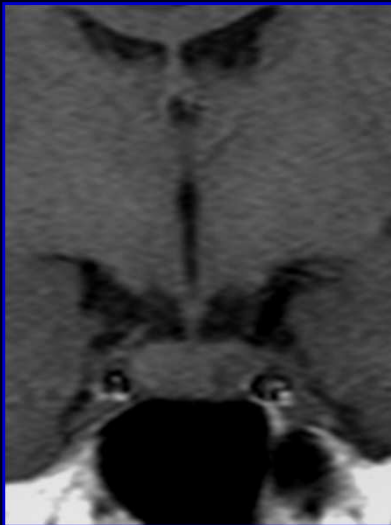


MORFOLOGIA

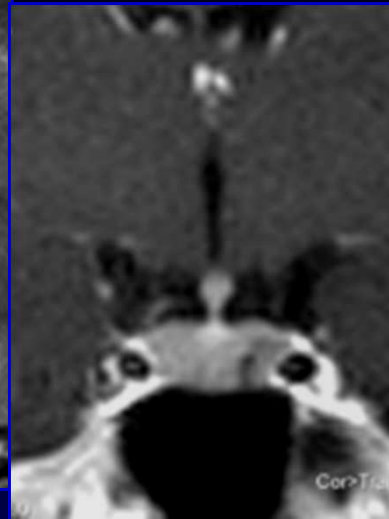
STRUTTURA

MICROADENOMA IPOFISARIO

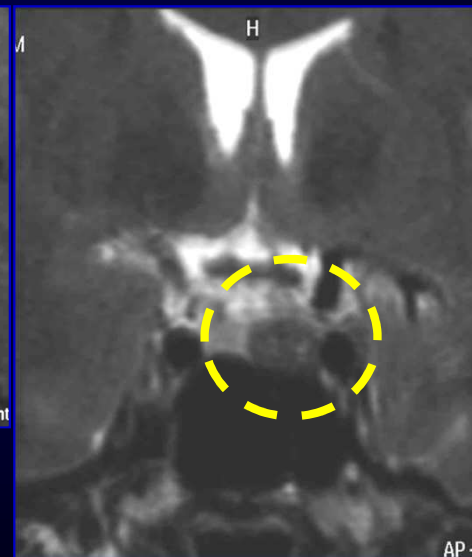
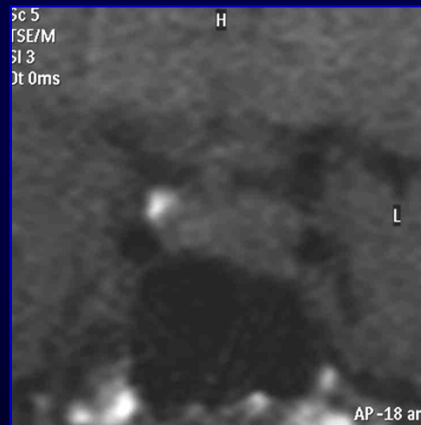
T₂



PRL



GH

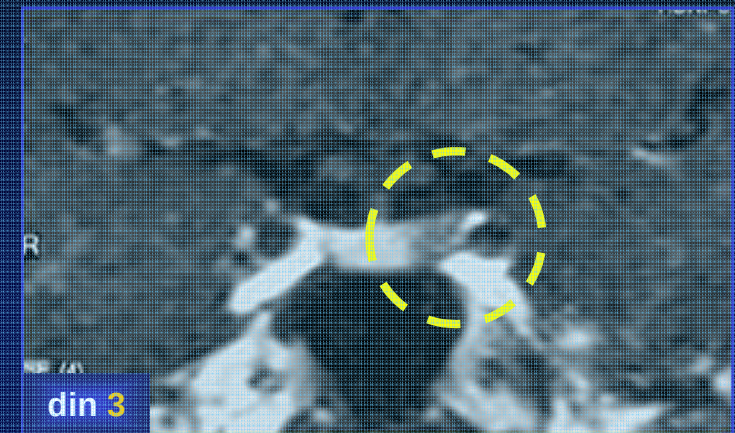
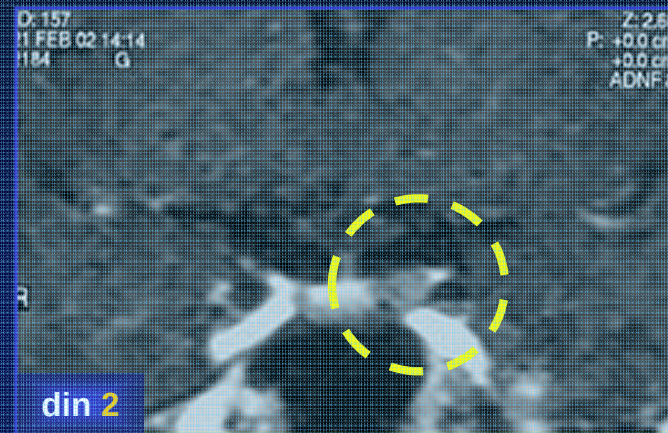
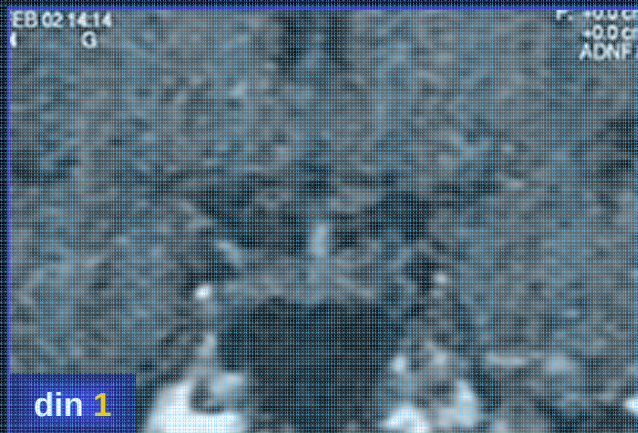


8/10 ADENOMI GH-SECERNENTI

ipointensi in T2

Hagiwara A et Al: *Comparison of GH- and non GH-producing adenomas: imaging characteristics and pathologic correlation.* **Radiology** 228: 533-538, 2003.

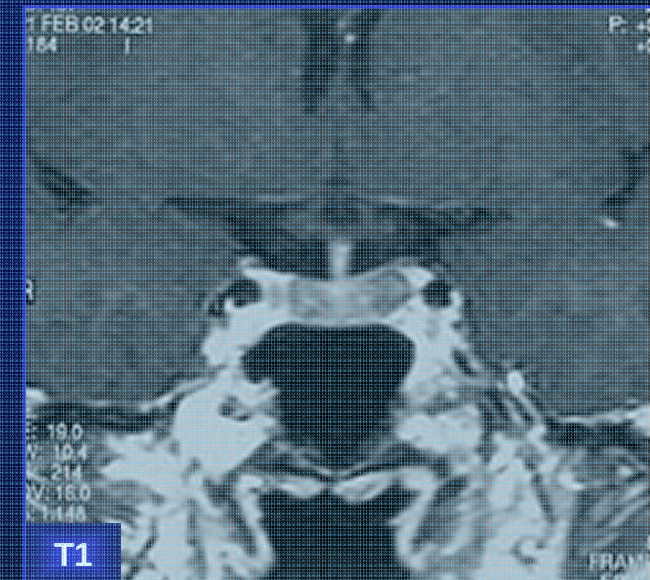
MICROADENOMA IPOFISARIO



SENSIBILITA'

■ DINAMICA **88,9%**

■ NON DINAMICA **61,1%**



Gao R, et Al: Dynamic gadolinium-enhanced MR imaging of pituitary adenomas: usefulness of sequential sagittal and coronal plane images. *Eur J Radiol* 39 (3):139-146, 2001.