



# Imaging in the diagnosis of oropharyngeal cancer: update & clinical impact

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## Imaging in a possible/presumed palatine tonsillar *T1N0 SCC*

### How Imaging may influence treatment planning?

- confirm/upstage T class
- rule out un-detected nodal metastases
- rule out distant metastases/second primary neoplasms
- identify prognostic factors imaging-related (other than TNM)
- confirm response to non-surgical treatment
- detect local/regional recurrences



## Oropharynx TNM 2002

**T1** Tumor 2 cm or less in greatest dimension

**T2** Tumor more than 2 cm but not more than 4 cm in greatest dimension

**T3** Tumor more than 4 cm in greatest dimension

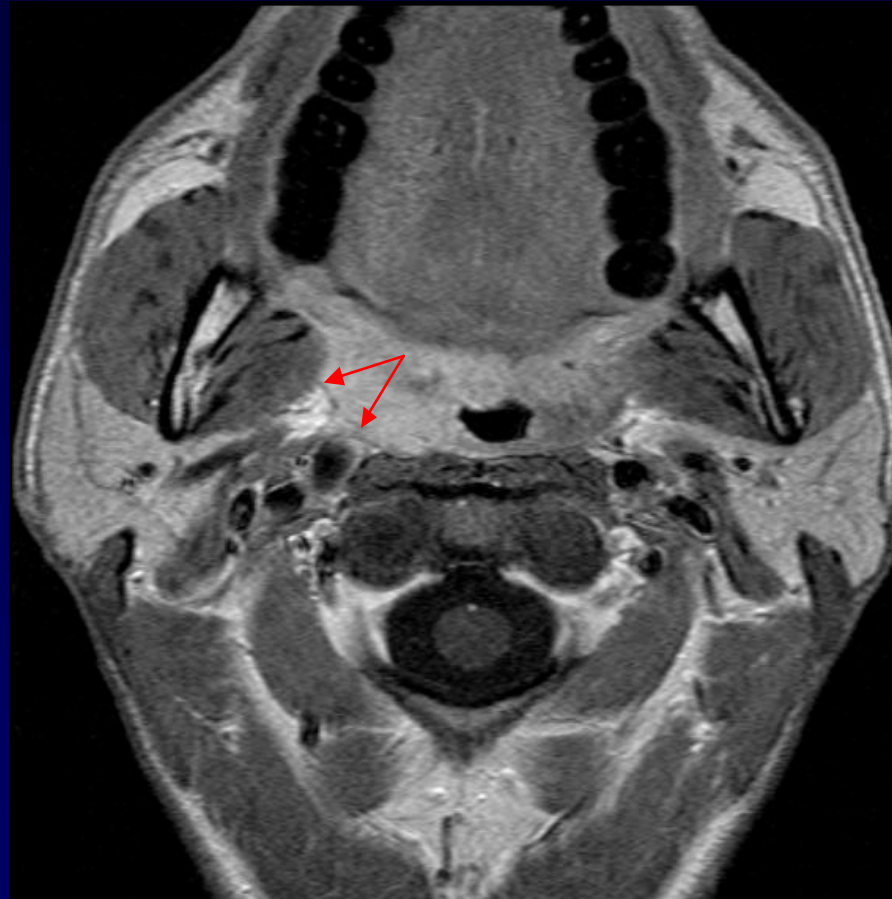
**T4a** Tumor invades the larynx, deep/extrinsic muscle of tongue, medial pterygoid, hard palate, or mandible

**T4b** Tumor invades lateral pterygoid muscle, pterygoid plates, lateral nasopharynx, or skull base or encases carotid artery



## Question 1. True T1?

- Assessment of adjacent structures involvement (growth limited to pharyngeal walls)
- Spread beyond the posterior pharyngeal lining (parapharyngeal/retropharyngeal extent)
- MR > CT



T



## Transoral lateral oropharyngectomy for squamous cell carcinoma of the tonsillar region: II. An analysis of the incidence, related variables, and consequences of local recurrence

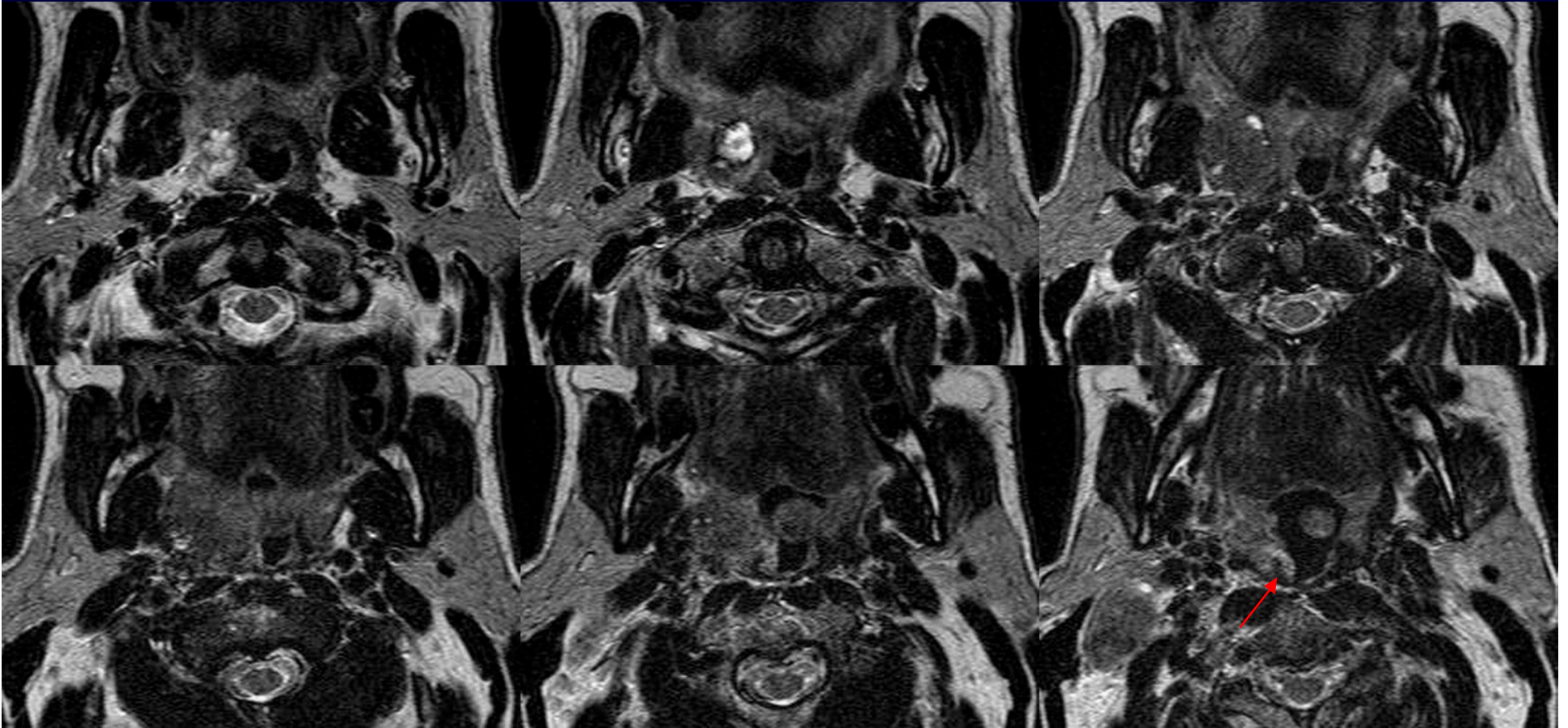
Laccourreye O. et al. (2005). Arch Otolaryngol Head Neck Surg 131: 592-9.

- 166 untreated pts with SCC of the tonsil. 81.9% received preoperative induction chemotherapy. 30.7% underwent postoperative RT

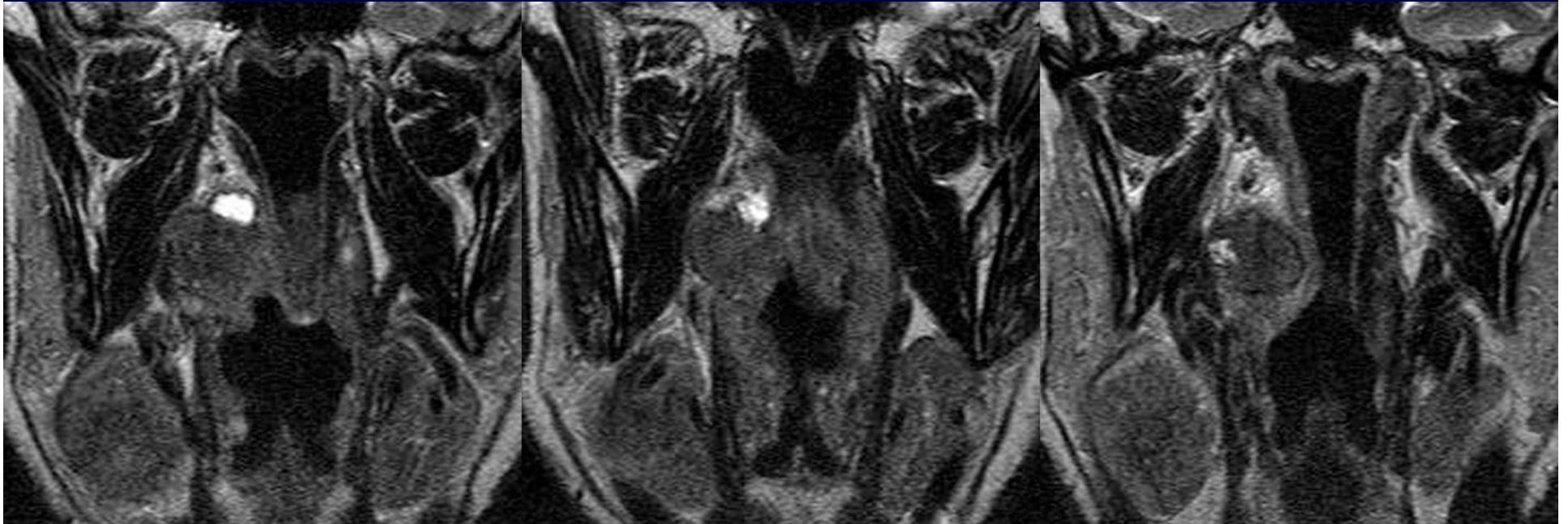
### 7 variables (univariate analysis)

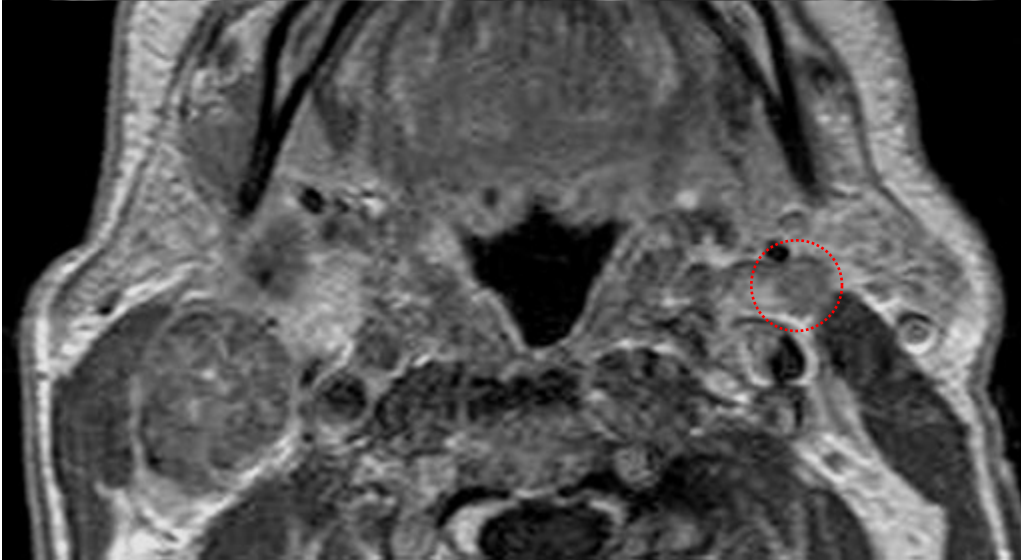
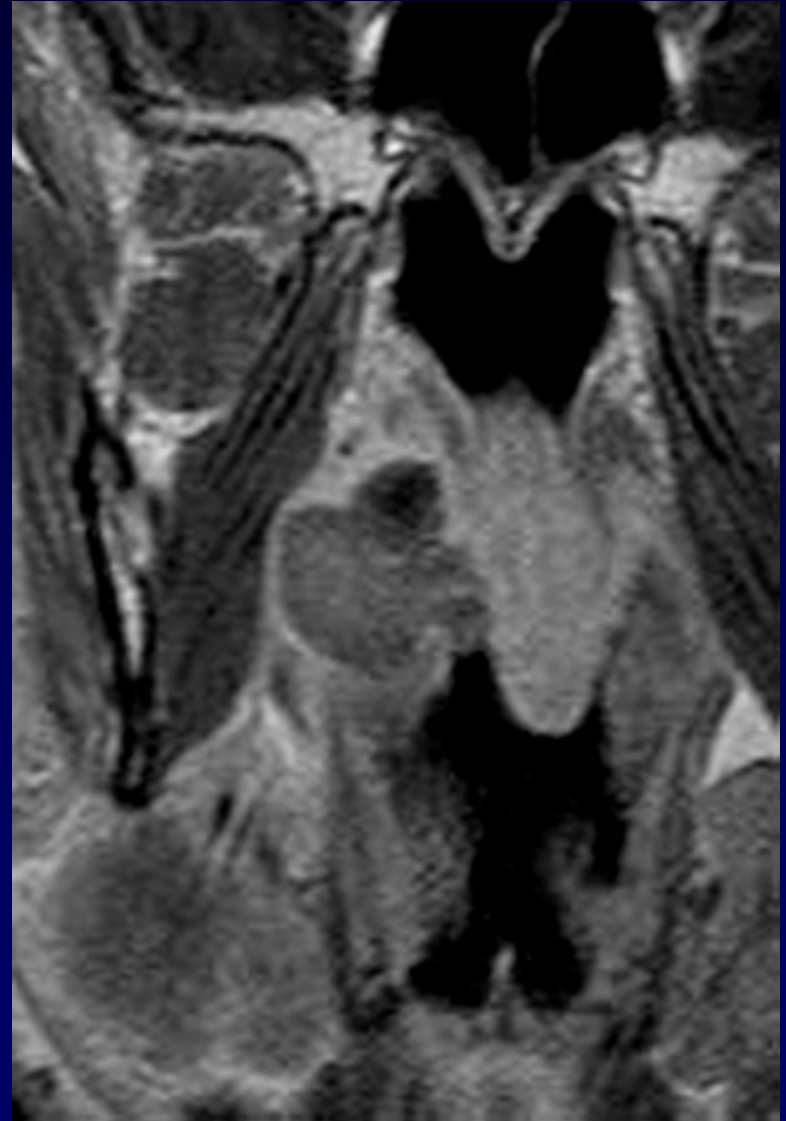
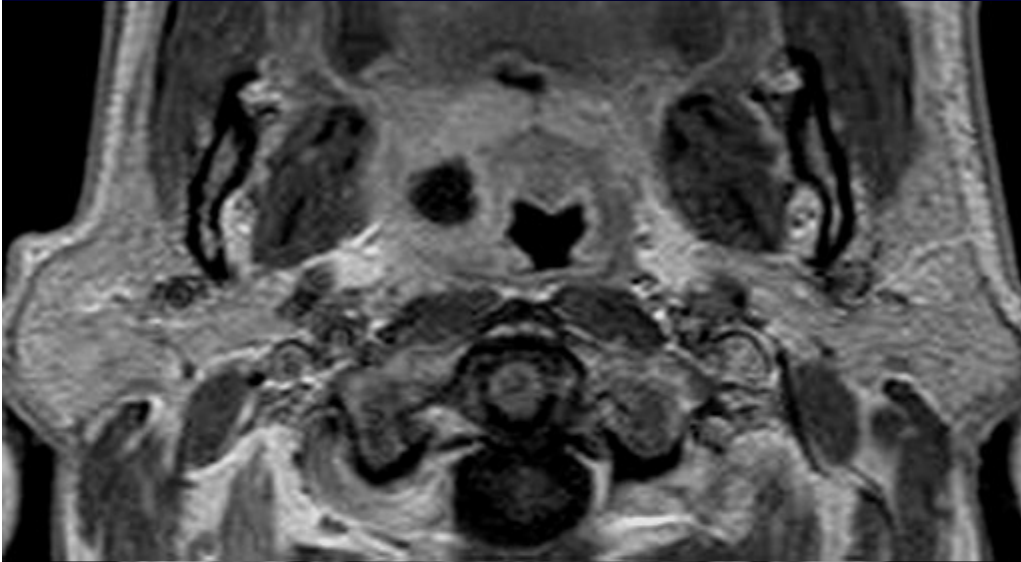
- Univariate analysis
  - Local recurrence
- increasing T classification;
  - positive margins of resection;
  - poor clinical response to induction chemotherapy;
  - tumor spread to the posterior pillar, posterior pharyngeal wall, and contralateral soft palate;
  - invasion of the junction between the tonsil and soft palate.







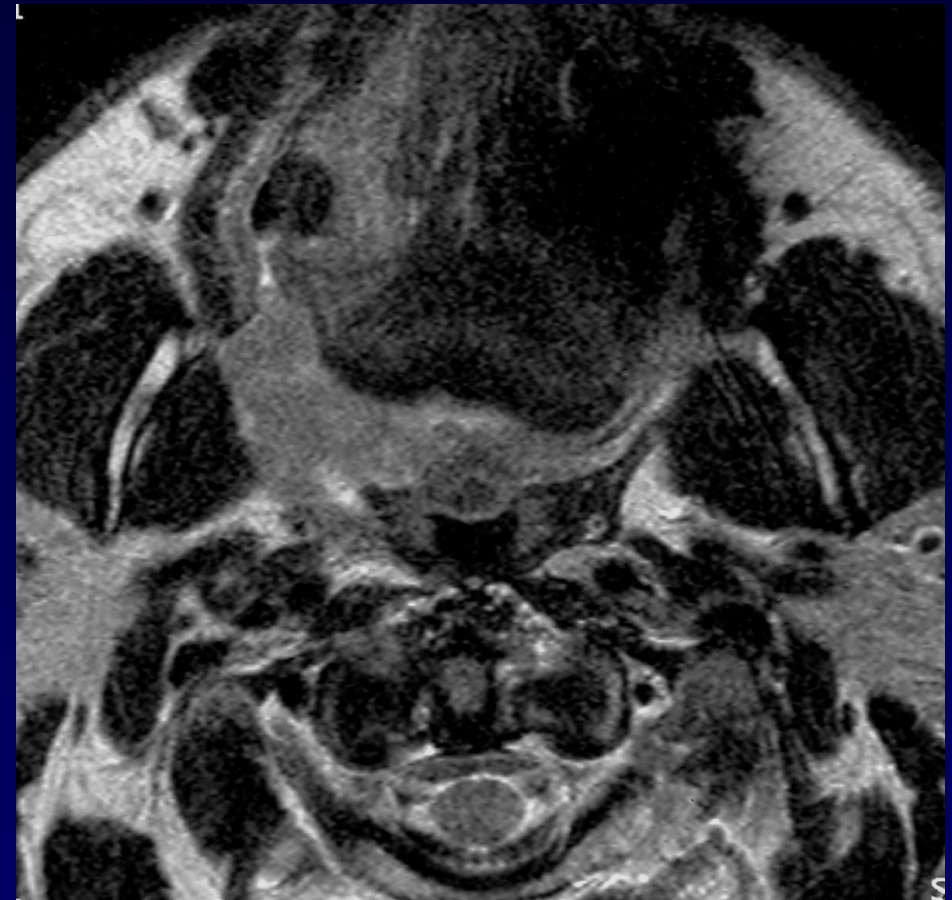






## Constrictor &/or stylopharyngeal mm invasion

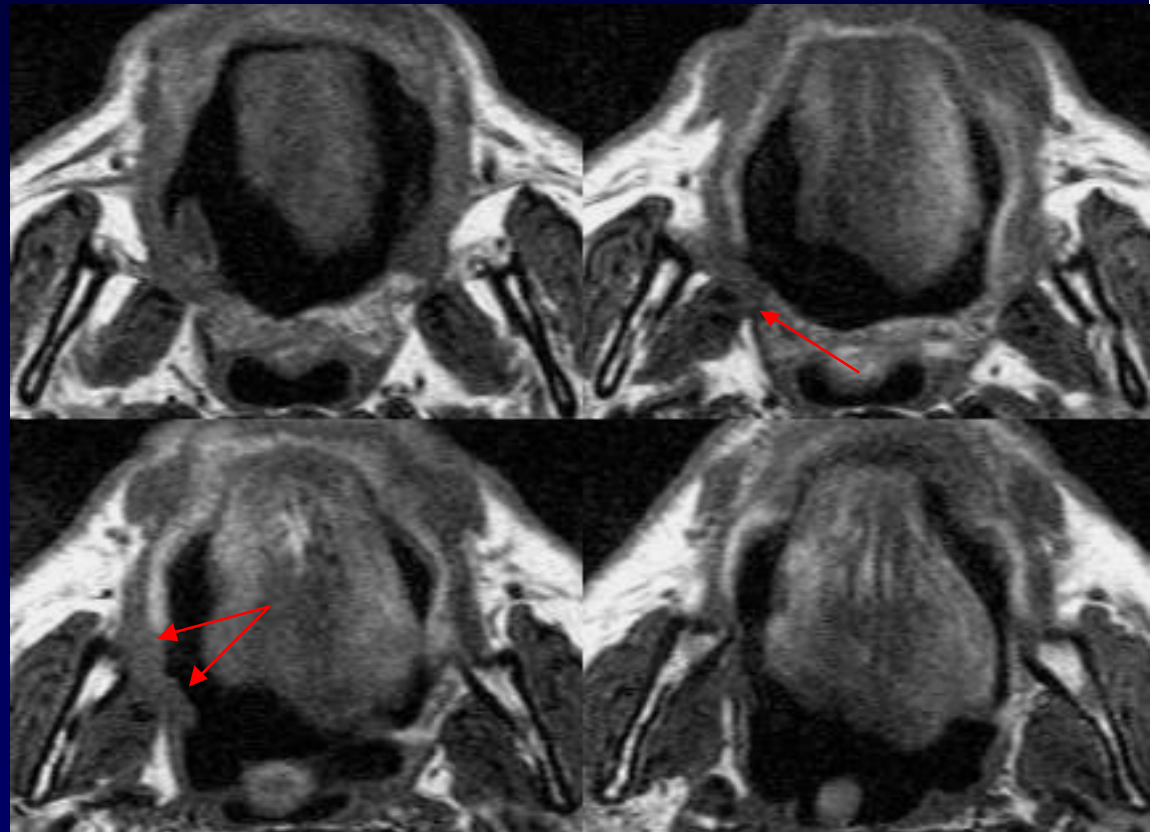
21 pts	MR vs histology
TP	8/21
TN	12/21
FP	0/21
FN	1/21
Sensitivity (%)	88.9
Specificity (%)	100
PPV (%)	100
NPV (%)	92.3

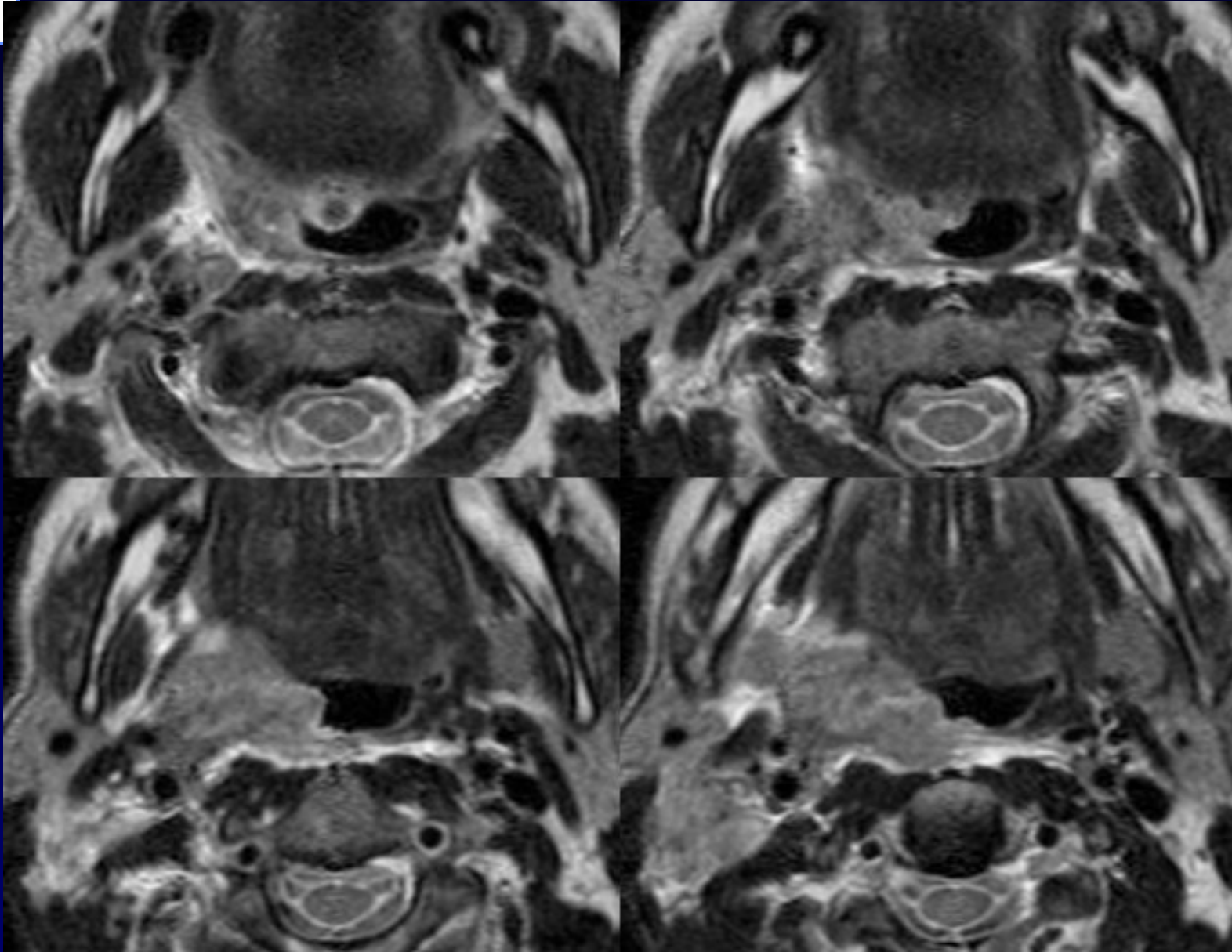


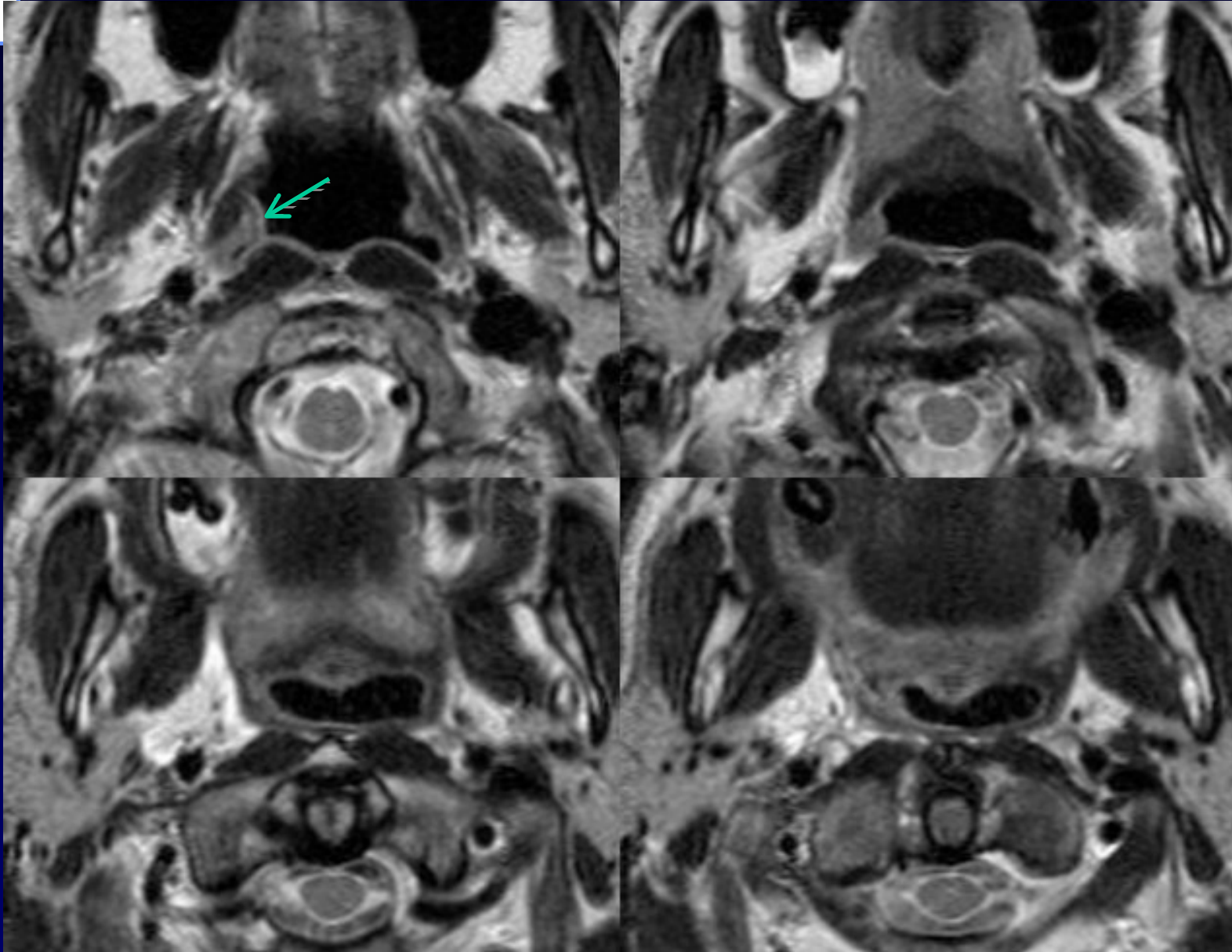


## Buccinator m invasion

Pts 32	MR vs histology
TP	8/22
TN	22/22
FP	2/22
FN	0/22
Sensitivity (%)	100
Specificity (%)	92
PPV (%)	80
NPV (%)	100







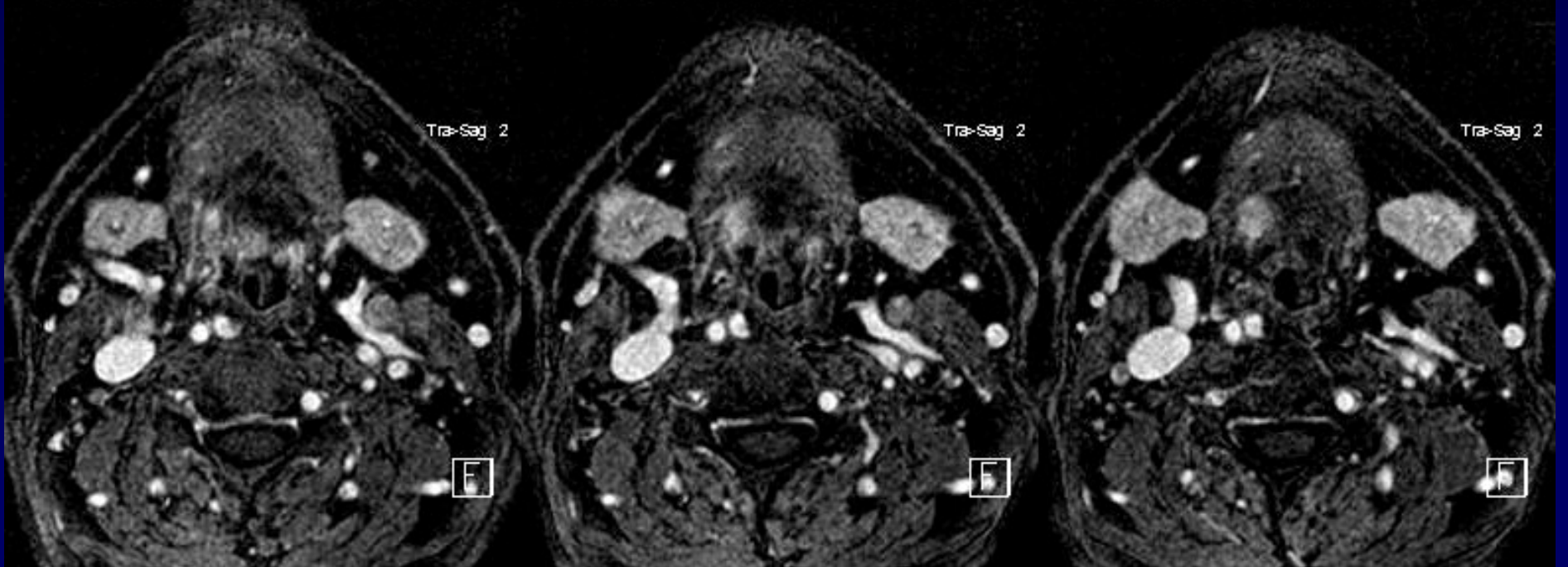




## Question 2. True N0?

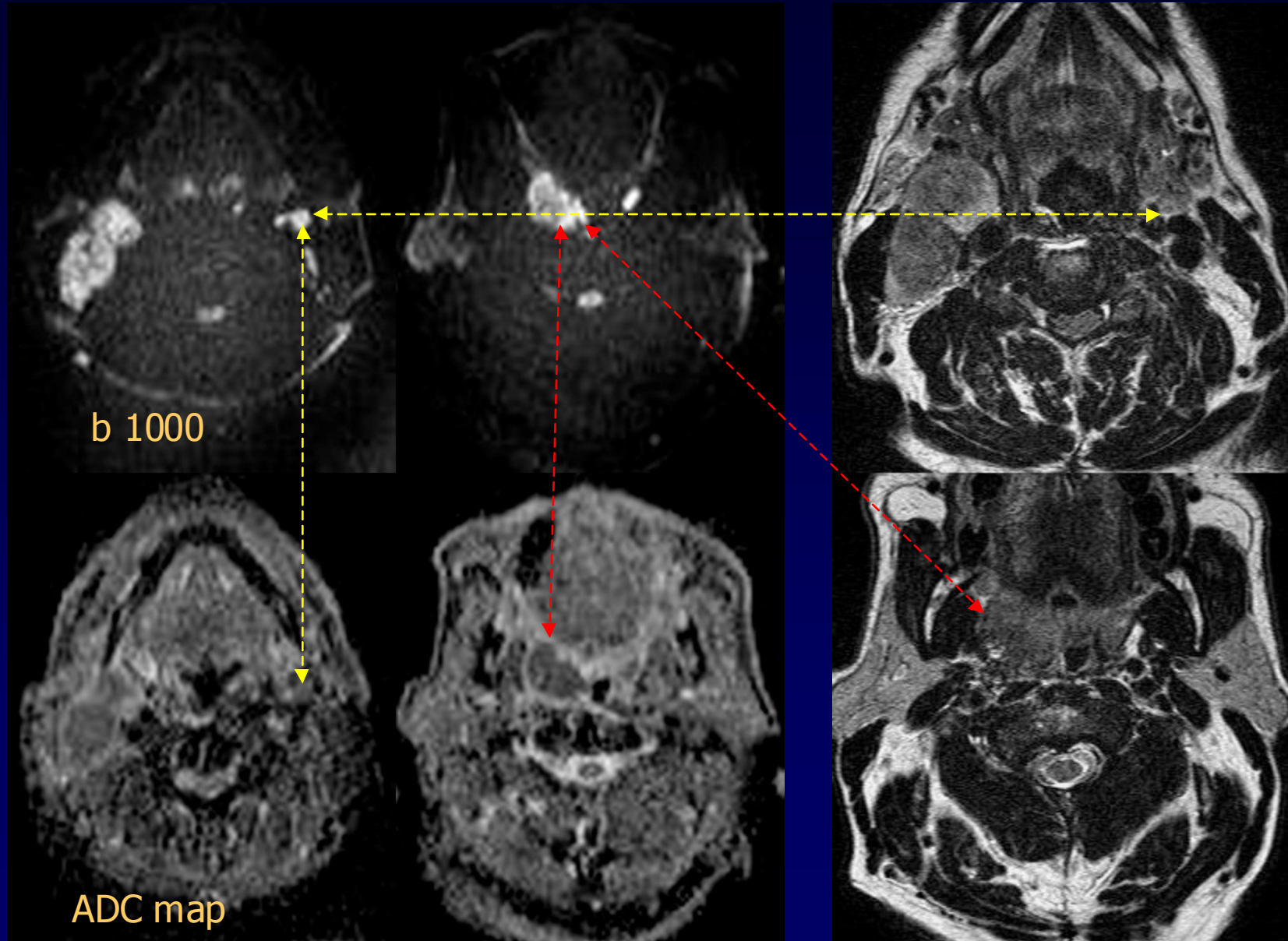
- Detect signs suggesting N+ in normal sized nodes
- Detect micrometastatic foci (< 3mm) within normal sized nodes
- **F-FDG PET-CT** > *Morphological* imaging (MR, CT, US)







# DW Imaging





## Diffusion Weighted-MR Imaging

- 32 patients, clinically suspected for recurrent head and neck cancer after surgery or radiation therapy.
- ADC value of  $1.30 \times 10^{-3} \text{ mm}^2/\text{s}$  threshold: **SE (84%), SP(90%), PPV (94%), NPV (76%)**.
- 26 patients suspected for persistent disease after radiotherapy the ADC values < HNSCC than nontumoral tissue **SE 94.6% and SP 95.5%** (Vandecaveye 2007)
- Compared to FDG-PET DW-MRI yielded fewer FP results at the primary site and at N;
- DWI-MRI identified subcentimetric nodal metastases not recognized by FDG-PET.

Abdel Razek A.A.K, Kandeel A.Y., Soliman N., et al. Role of diffusion- weighted echo planar MR imaging in differentiation of residual or recurrent head and neck tumors and posttreatment changes. AJNR 2007;28:1146-1152

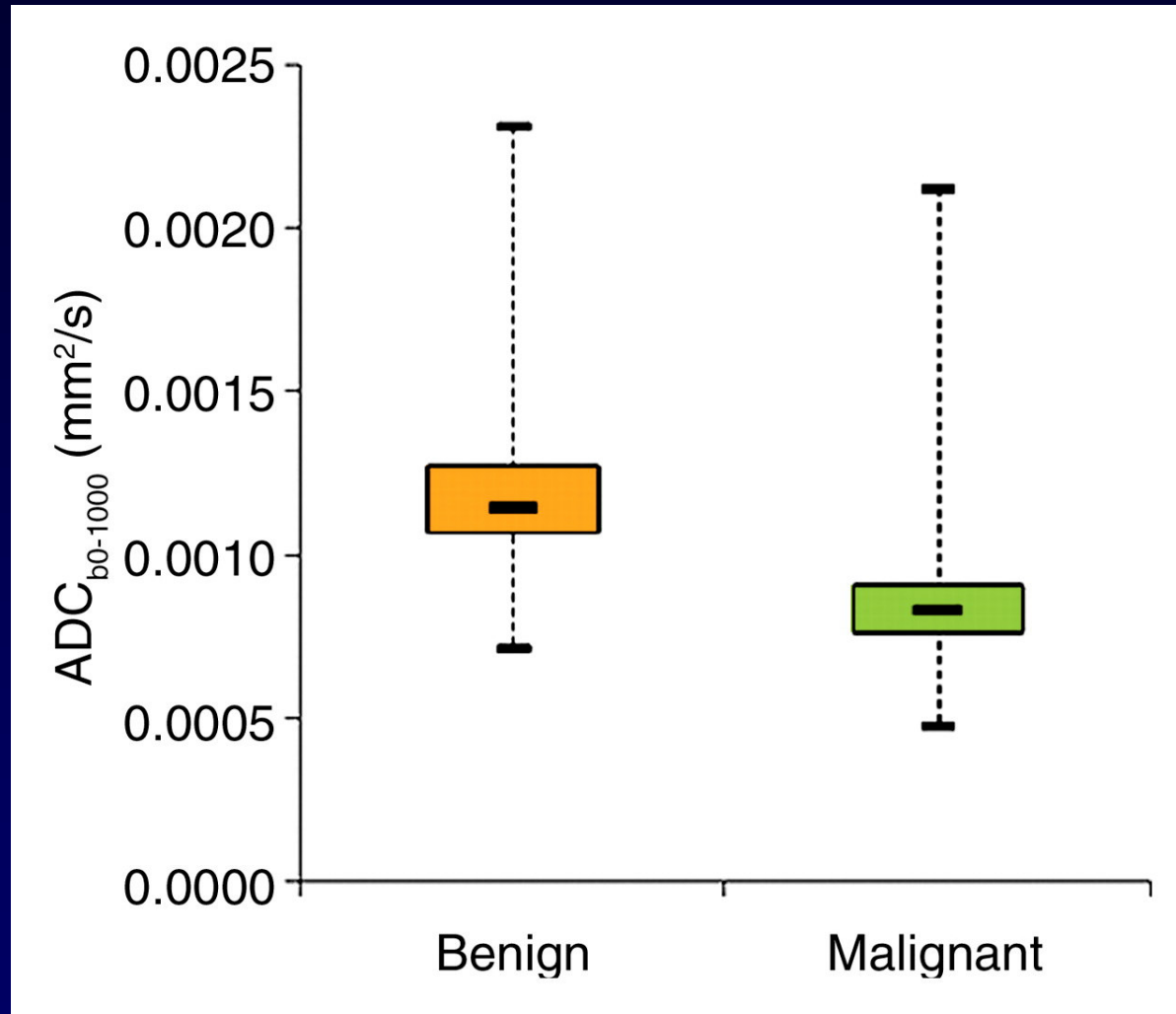


## DWI-MR Imaging, sub-centimetric nodes

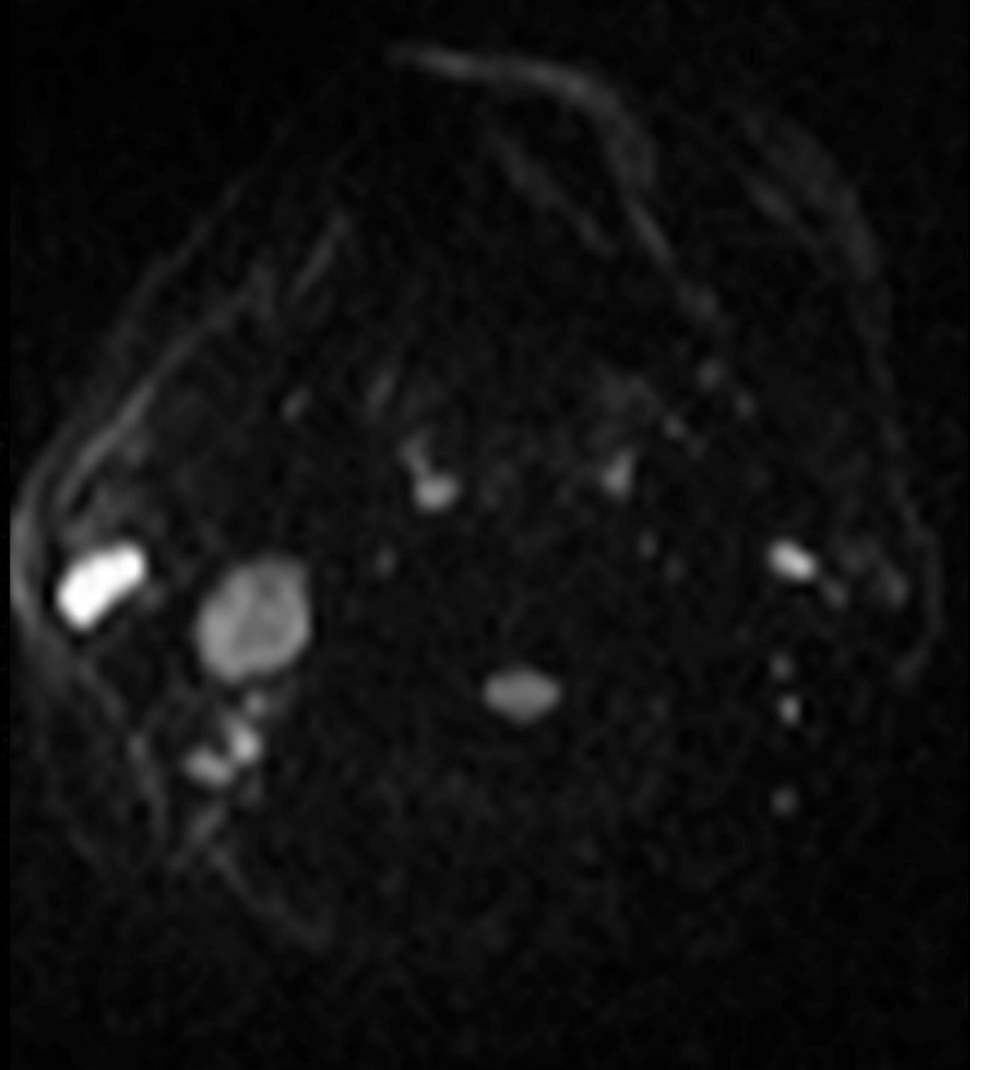
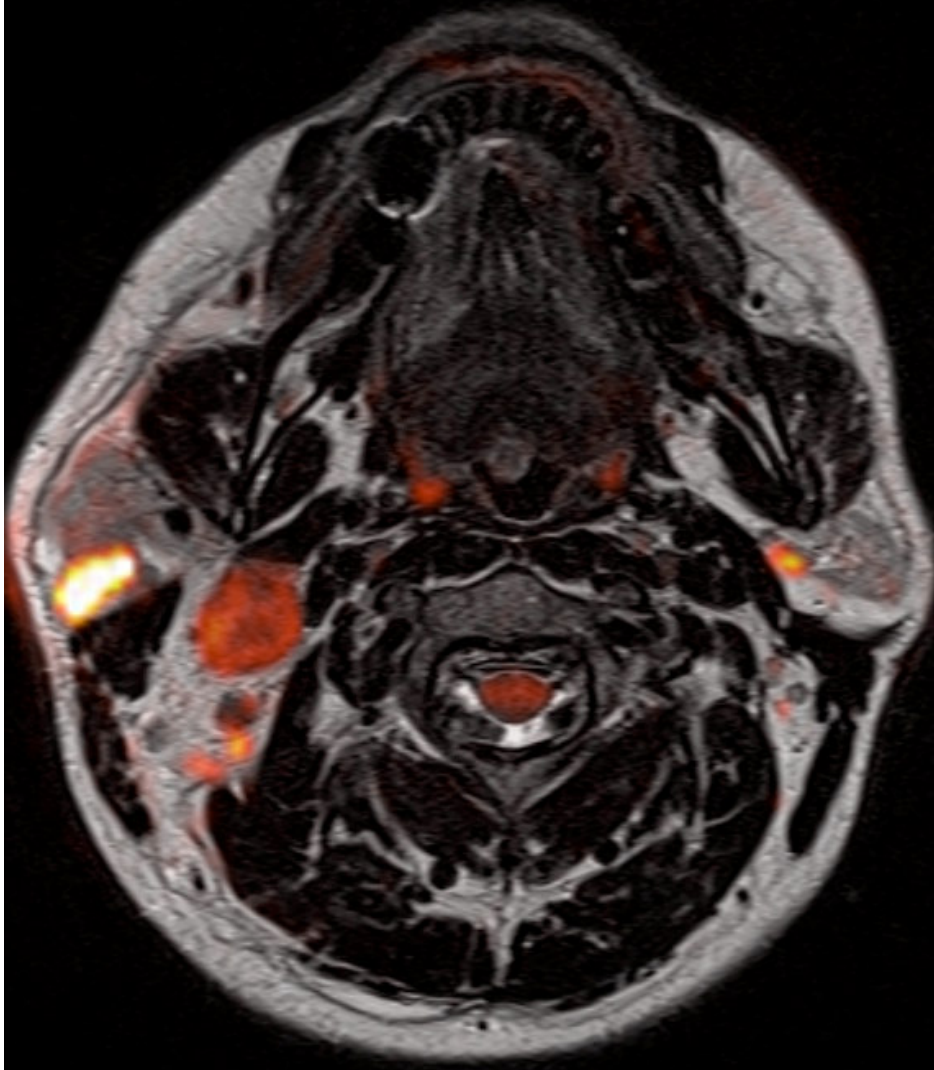
- 301 lymph nodes, pathologic matching.
- optimal ADC  $b_0^{-1000}$  threshold of  $0.94 \times 10^{-3} \text{ mm}^2/\text{sec}$ ,
  - 84% sensitivity, 94% specificity, and 91% accuracy for differentiation of malignant versus benign status of each lymph node
  - 94% sensitivity, 97% specificity, and 97% accuracy for differentiation at each neck level were achieved.
  - DW imaging sensitivity 76%, specificity 94.0% for detection of subcentimeter nodal metastases.



## Box-whisker plots of ADC<sub>b0-1000</sub> values for 4-9-mm lymph nodes

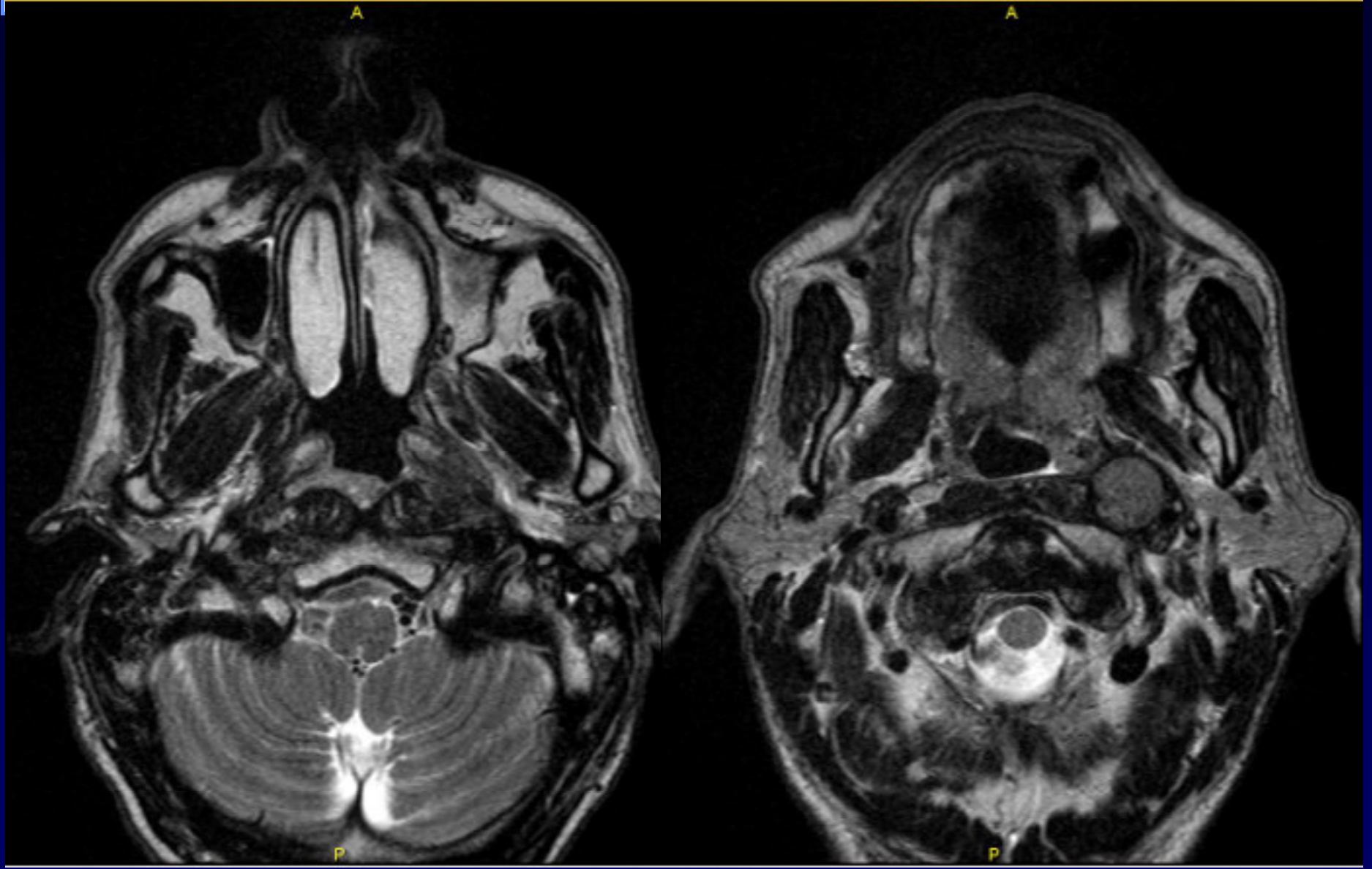


Vandecaveye, V. et al. Radiology 2009;251:134-146





# Nasopharyngeal undiff. carcinoma

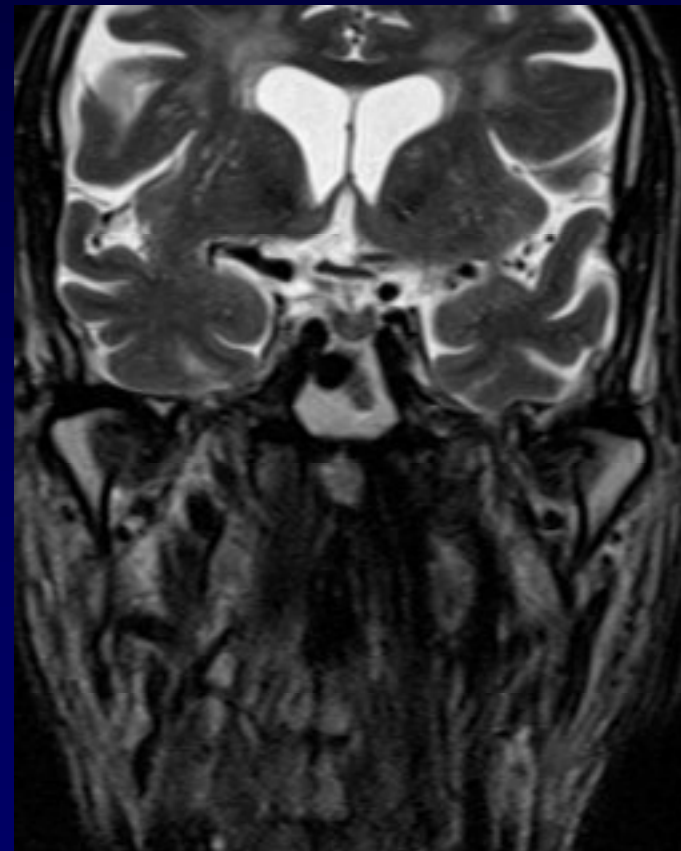
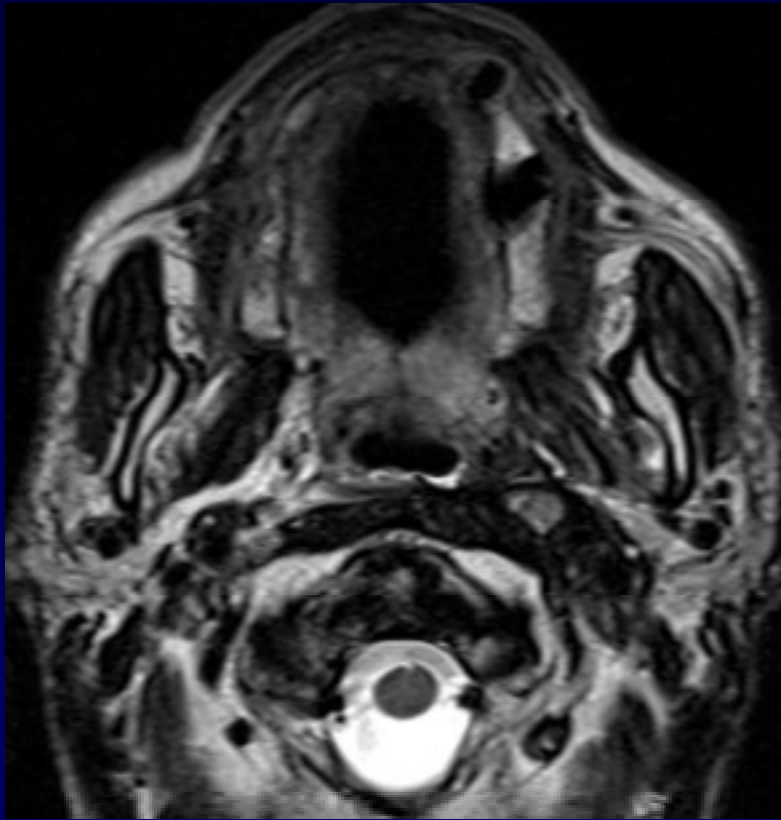


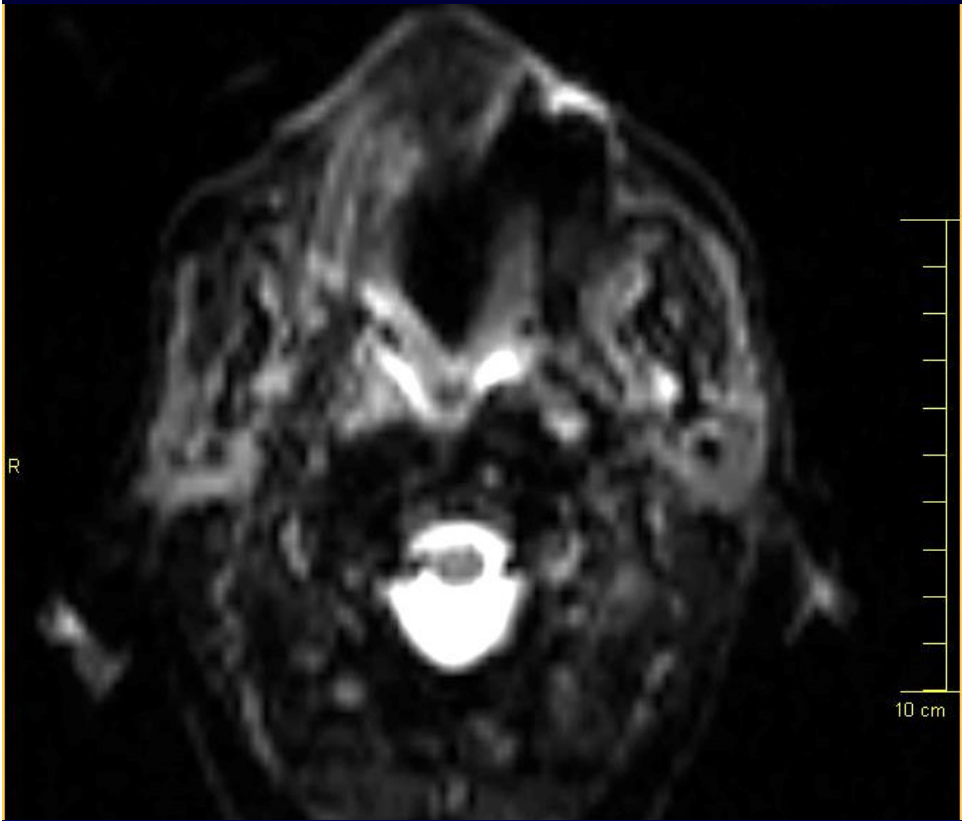




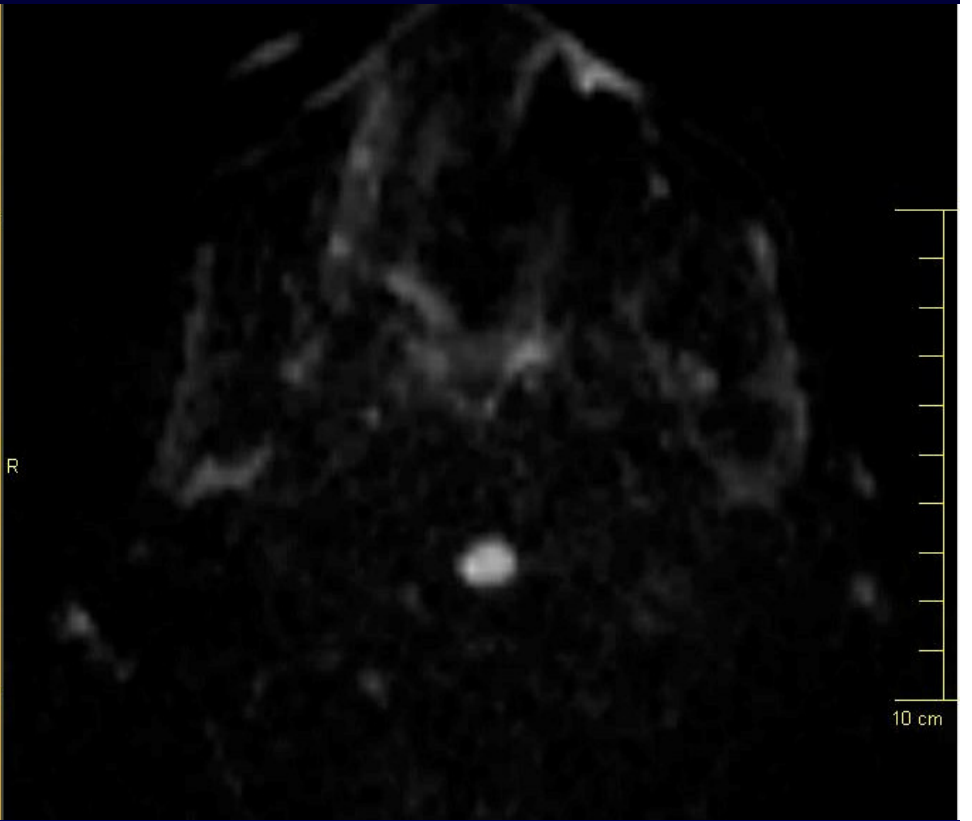


## Follow up MR 11 months after RT

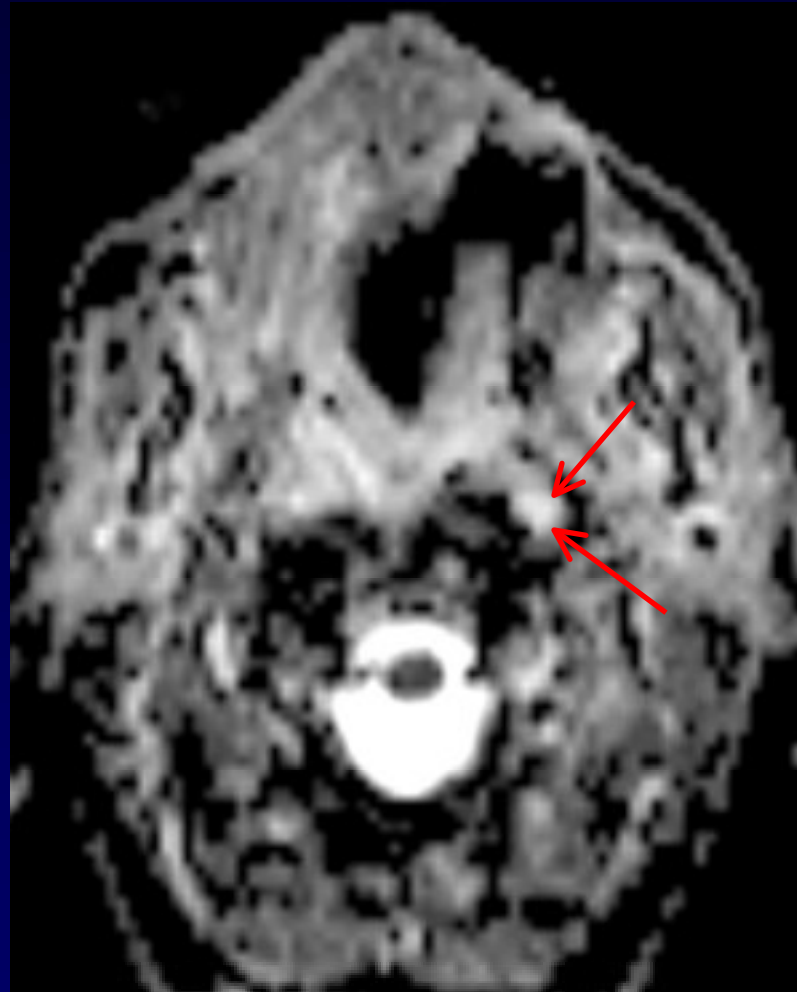




**b0**



**b1000**





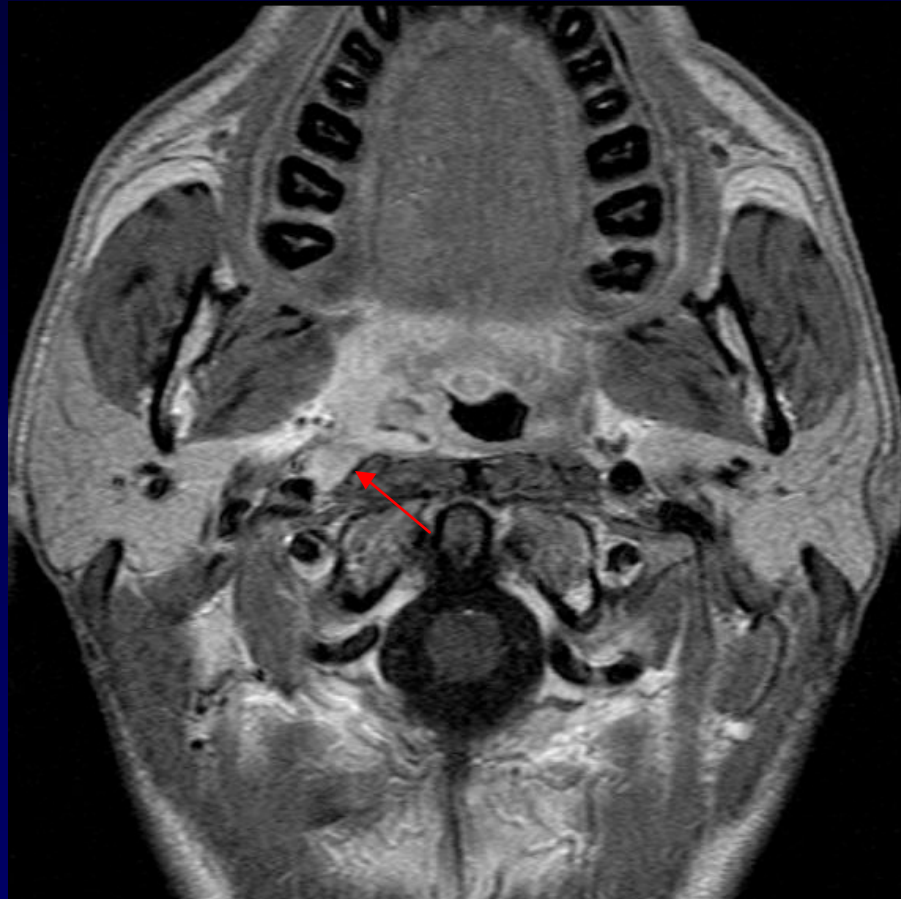
## 18F-FDG PET/CT for detecting nodal metastases in patients with oral cancer staged N0 by clinical examination and CT/MRI.

Schoder H., D. L. Carlson et al. (2006). J Nucl Med 47(5): 755-62.

- prospective study, 31 pts with oral cancer and N0 by clinical exam or CT/MR.
- 13 of 765 dissected lymph nodes harbored metastases.
- 3 FN on CT-PET: metastases smaller than 3 mm or inability to distinguish between primary tumor and adjacent metastasis.
- SE, SP 67% and 85% on the basis of neck sides and 67% and 95% on the basis of number of nodal levels, respectively.
- If a decision regarding the need for neck dissection had been based solely on PET/CT, 3 FN necks would have been undertreated, and 4 FP necks would have been overtreated.



## The retro(lateral)pharyngeal node(s)



N



## Retropharyngeal nodes (RP) in squamous cell carcinoma of oropharynx: incidence, localization, and implications for target volume

Bussels B., R. Hermans et al. (2006). Int J Radiat Oncol Biol Phys 65(3): 733-8.

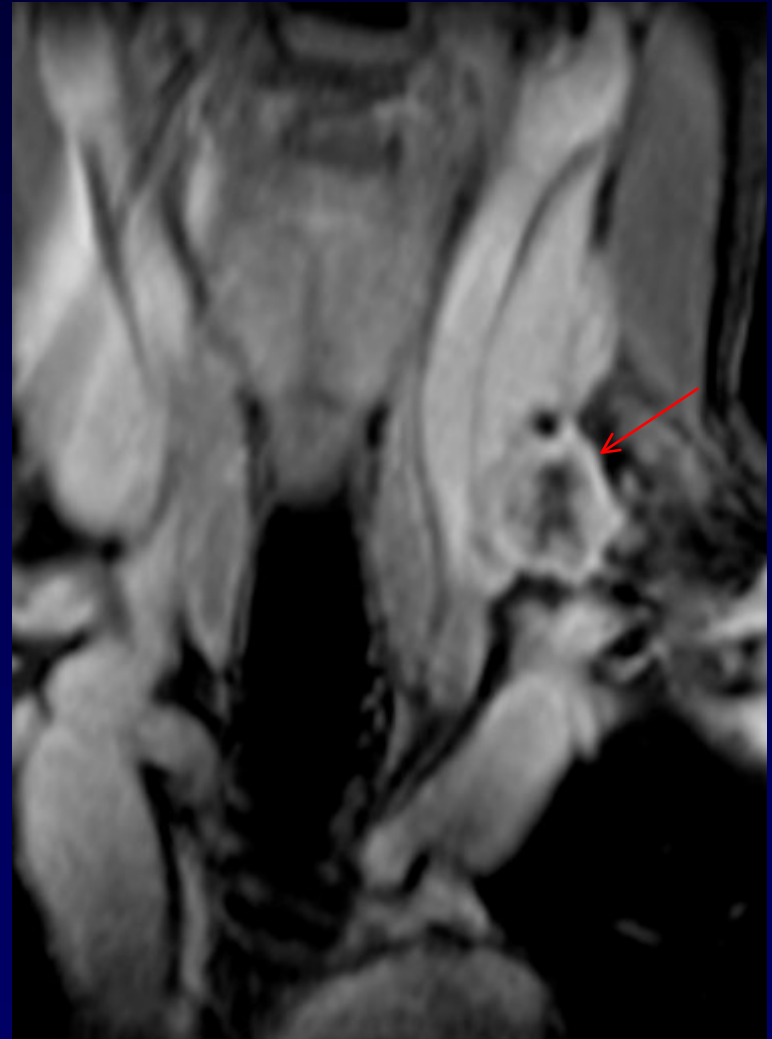
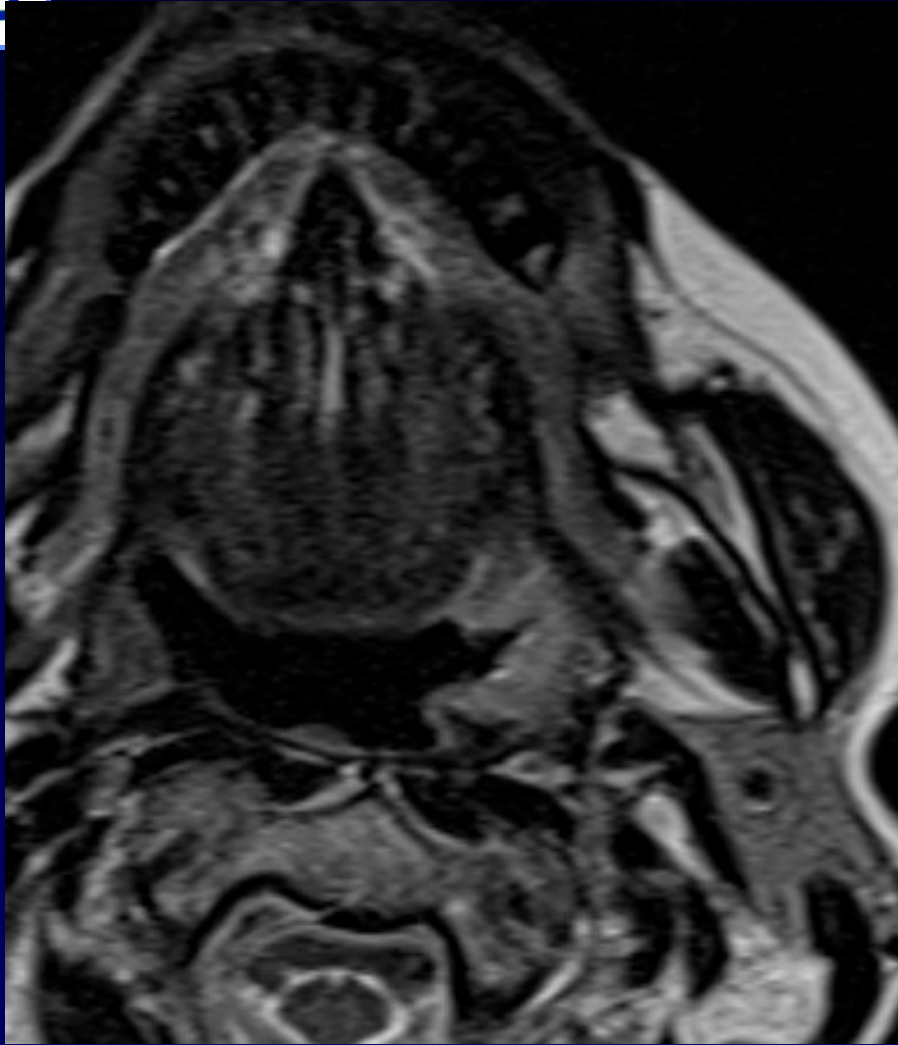
- Retrospective analysis of CT studies of 208 pts with oropharyngeal SCC.
- RP adenopathies present in 16% of all pts and in **23% of pts with nodal disease in other neck sites.**
- Ipsilateral involvement of Level II and contralateral involvement of Level III predicted for involvement of the ipsilateral RP nodes on multivariate analysis ( $p < 0.05$ ).
- A solitary ipsilateral RP node was present in 3 (9%) of 34 patients with RP nodes; 2 of these 3 patients had a **primary posterior pharyngeal wall tumor.** No patients presented with a solitary contralateral RP node.



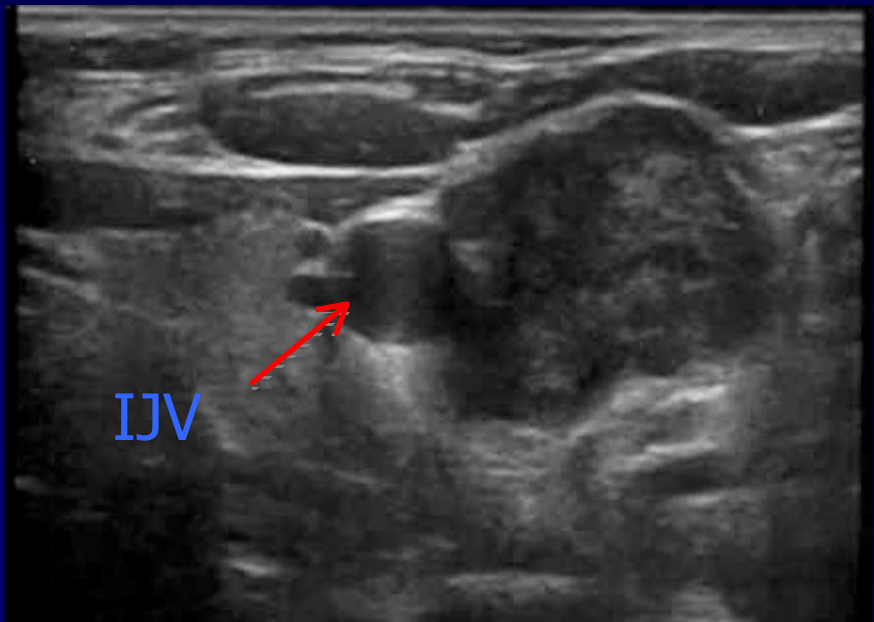
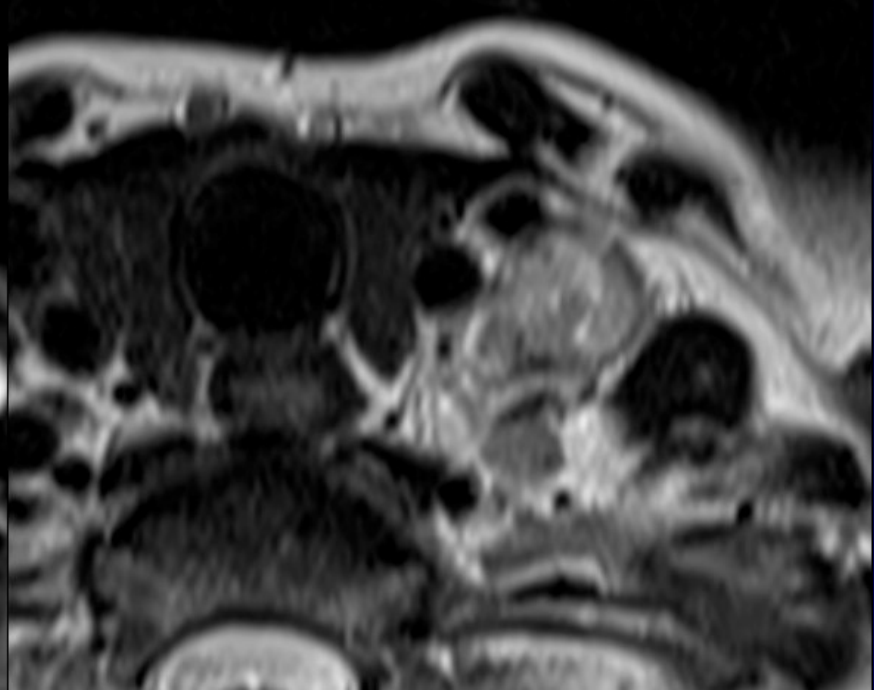
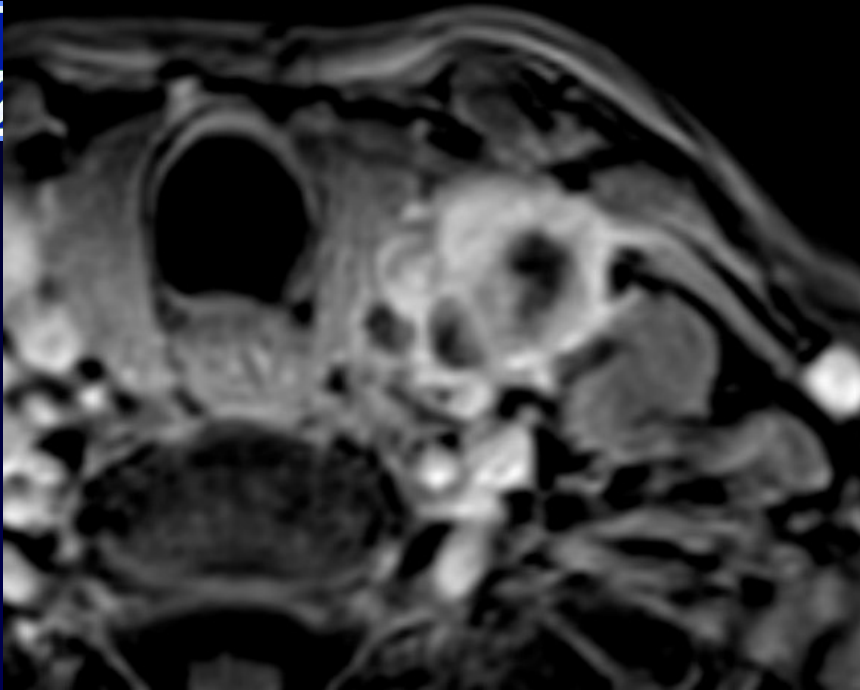
## Prognostic influence of retropharyngeal lymph node metastasis in squamous cell carcinoma of the oropharynx

Dirix, P., S. Nuyts, et al. (2006). Int J Radiat Oncol Biol Phys 65(3): 739-44

- Pts treated between 1984 and 2003: by RT alone (84.1%), by surgery with postoperative RT in 11.5%, and by concomitant CT in 4.4%.
- Retropharyngeal node involvement was present in 34 (16%) pts.
- At 5 years, patients with retropharyngeal adenopathy had significantly **more regional recurrences** (45% vs. 10%,  $p = 0.004$ ).
- Involvement of retropharyngeal lymph nodes significantly (**relative risk 4.29** [95% confidence interval 3.33-5.25],  $p = 0.01$ ) and independently predicted regional recurrence in multivariate analysis.
- Disease-specific survival was significantly lower in the retropharyngeal node positive group (38% vs. 58%,  $p = 0.03$ ).









## Question 3. True M0? Other synchronous neoplasms?

- Detect distant metastasis
- Differentiate primary pulmonary NSCC from M+
- F-FDG PET-CT > CT



Imaging in a possible/presumed advanced  
tongue base *SCC*



## Imaging in a possible/presumed advanced tongue base *SCC*

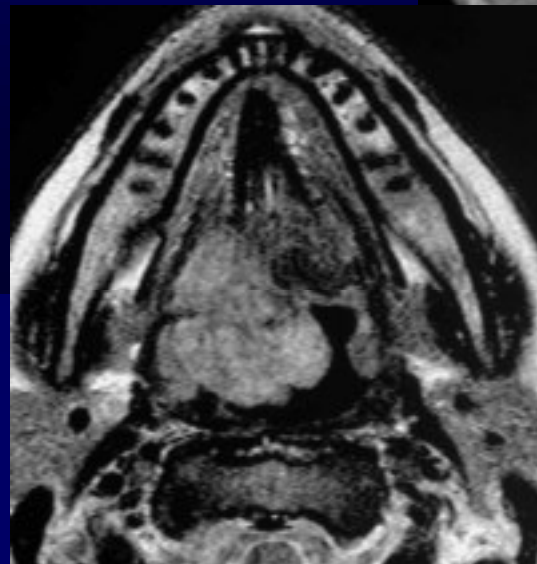
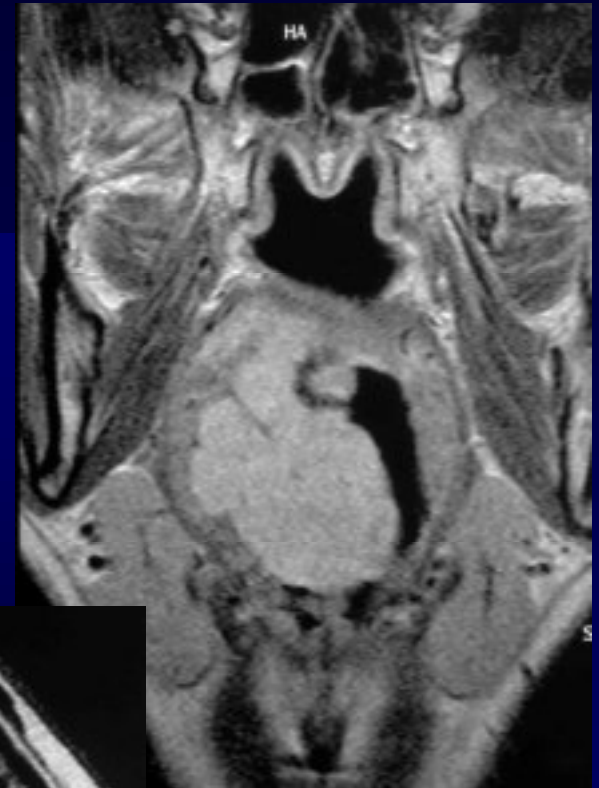
### How Imaging may influence treatment planning?

- confirm/upstage T class
- precise deep tumor extent
- rule out un-detected contralateral nodal metastases
- detect extracapsular spread
- rule out distant metastases/second primary neoplasms
- confirm response to non-surgical treatment
- detect local/regional recurrences



## Question 1. Deep extent?

- Assessment of tongue base invasion
- Spread beyond tongue base
- Assess T class
- **MR** > CT





# Oropharyngeal SCC: pre-treatment evaluation

## Clinical examination

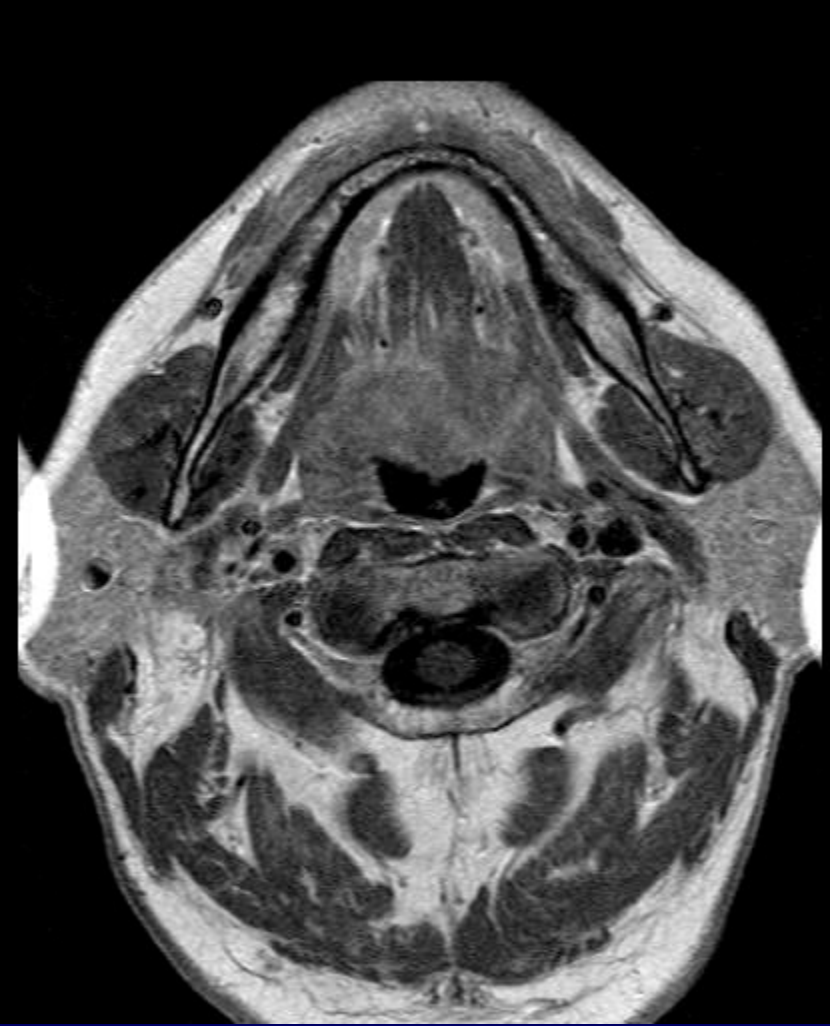
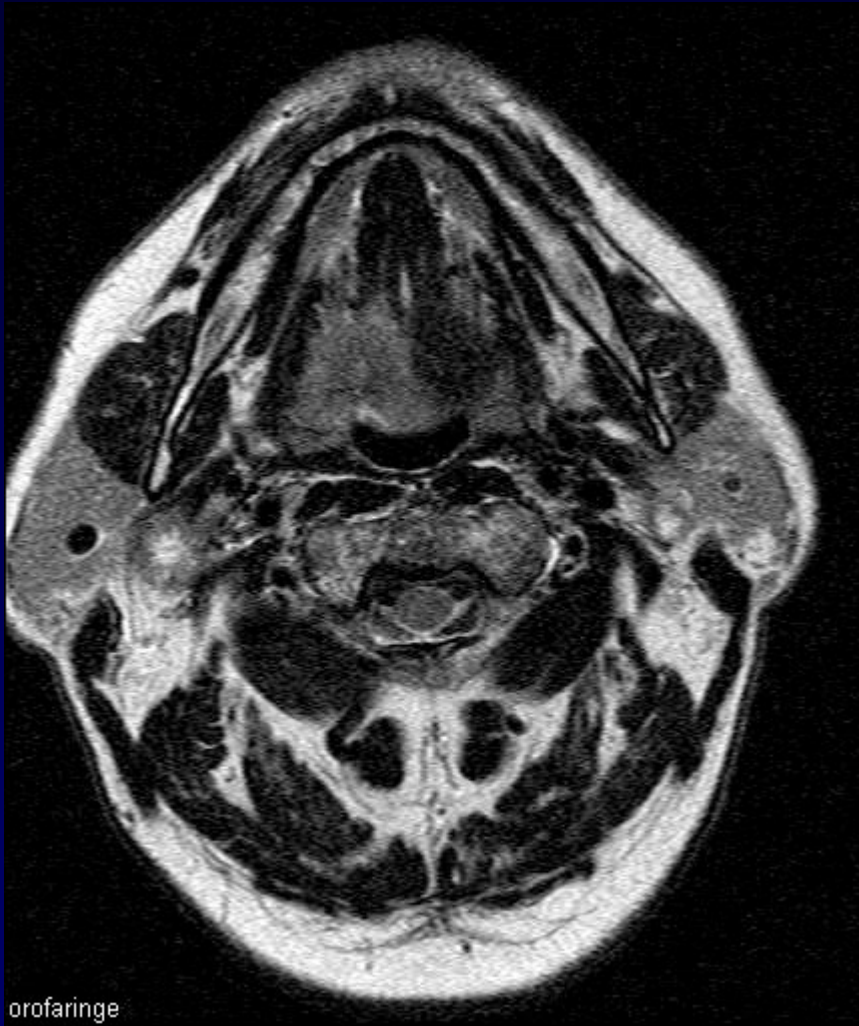
- duration of symptoms
- referred otalgia
- Trismus
- infiltrating vs exophytic lesion
- comorbidities (!)

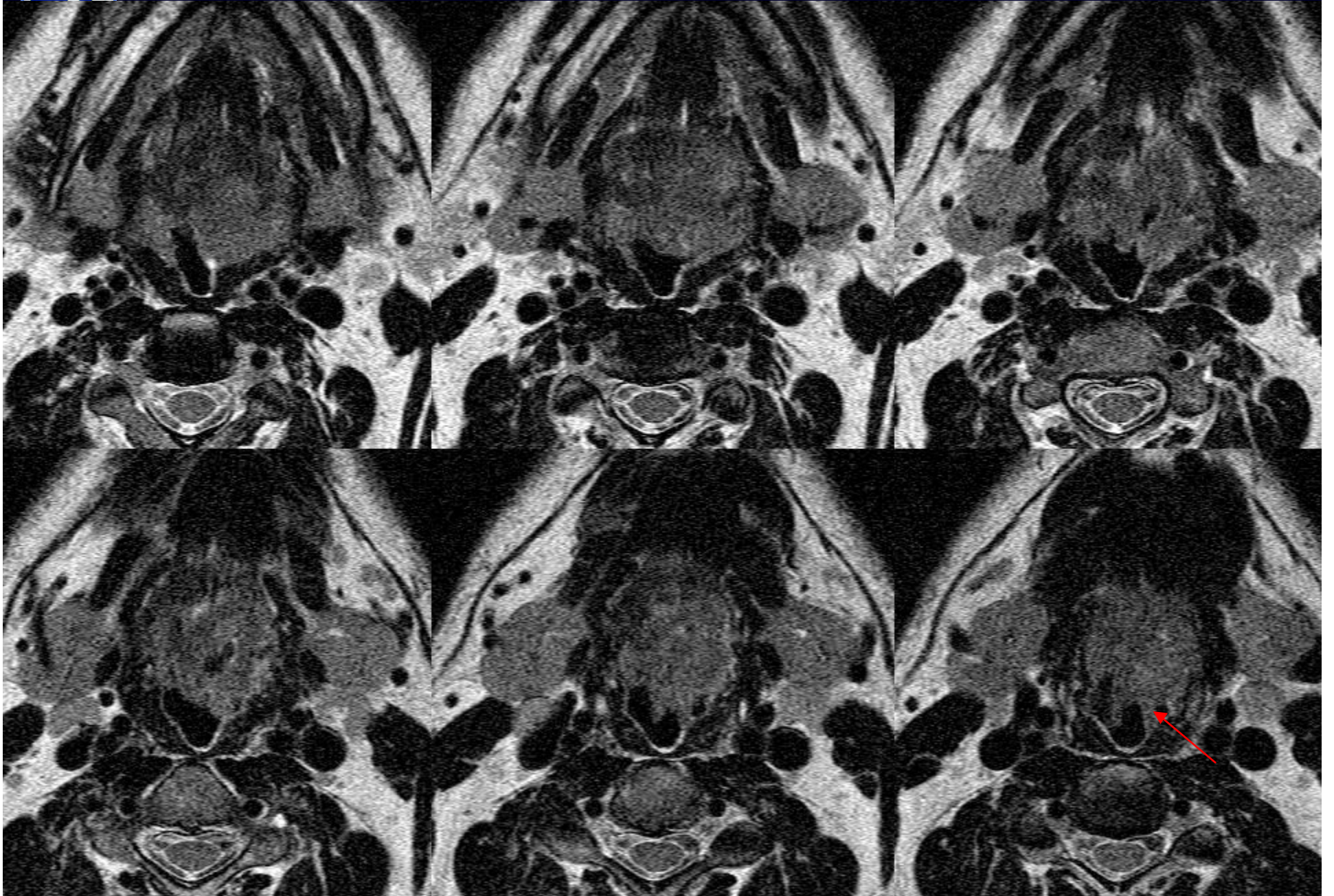
## Imaging (MR/CT)

- soft tissue extension
- mandibular involvement
- pterygoid muscles and plates
- styloid muscles
- hypoglossal nerve(s)
- lingual arterie(s)
- nasopharyngeal extension

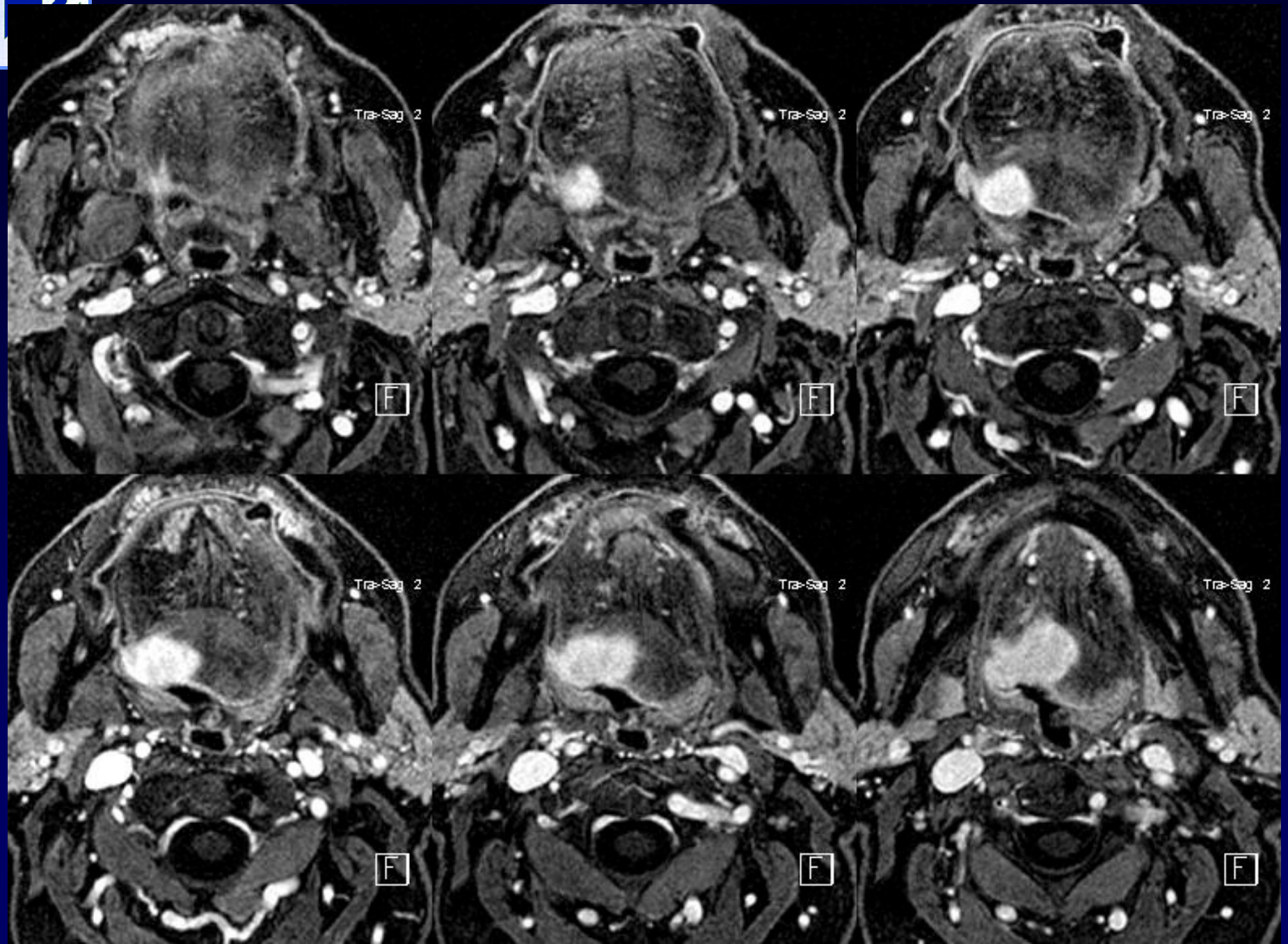


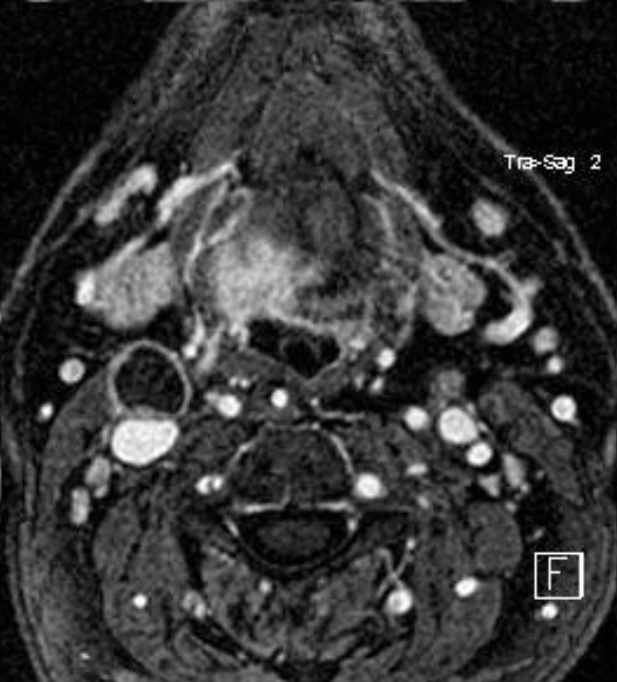
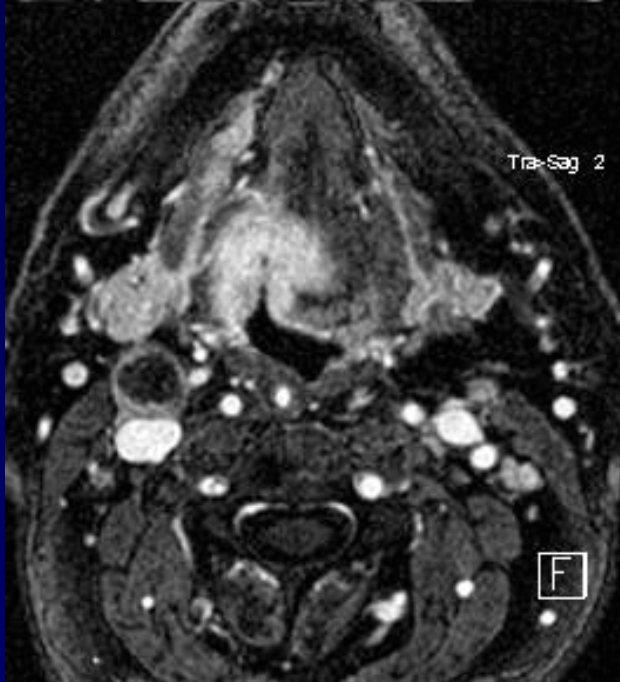
## Tumor limited to tongue base

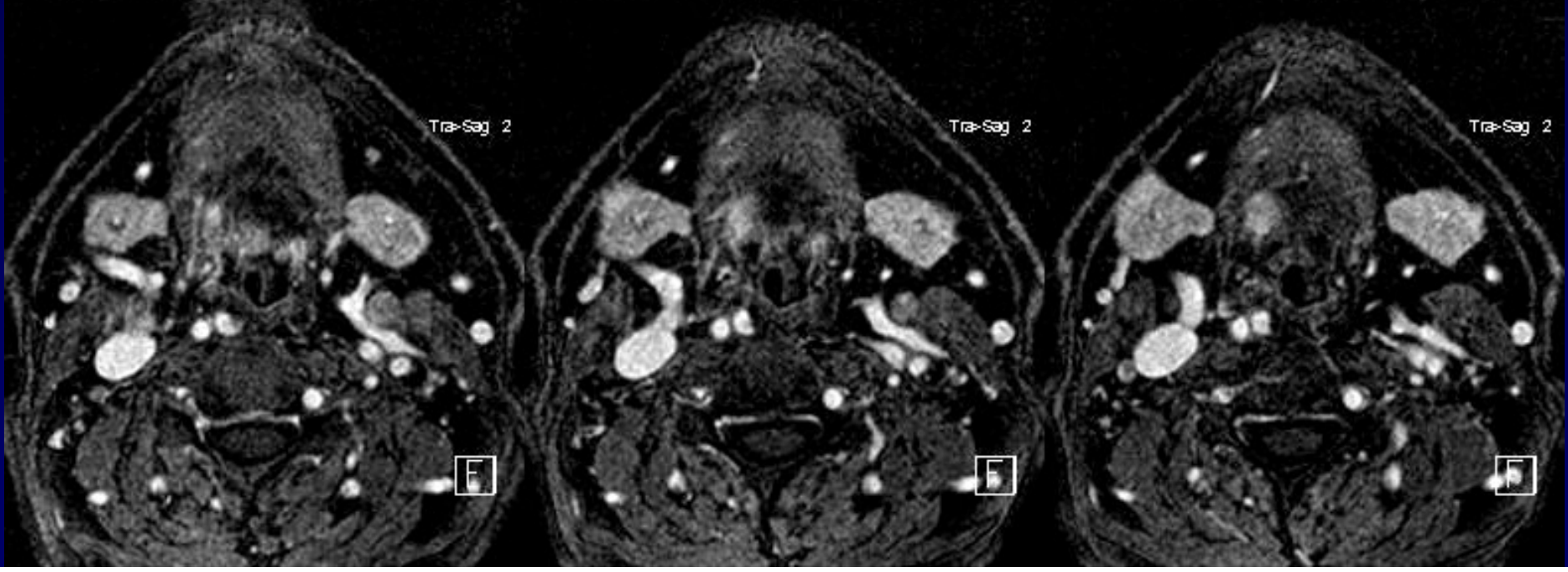






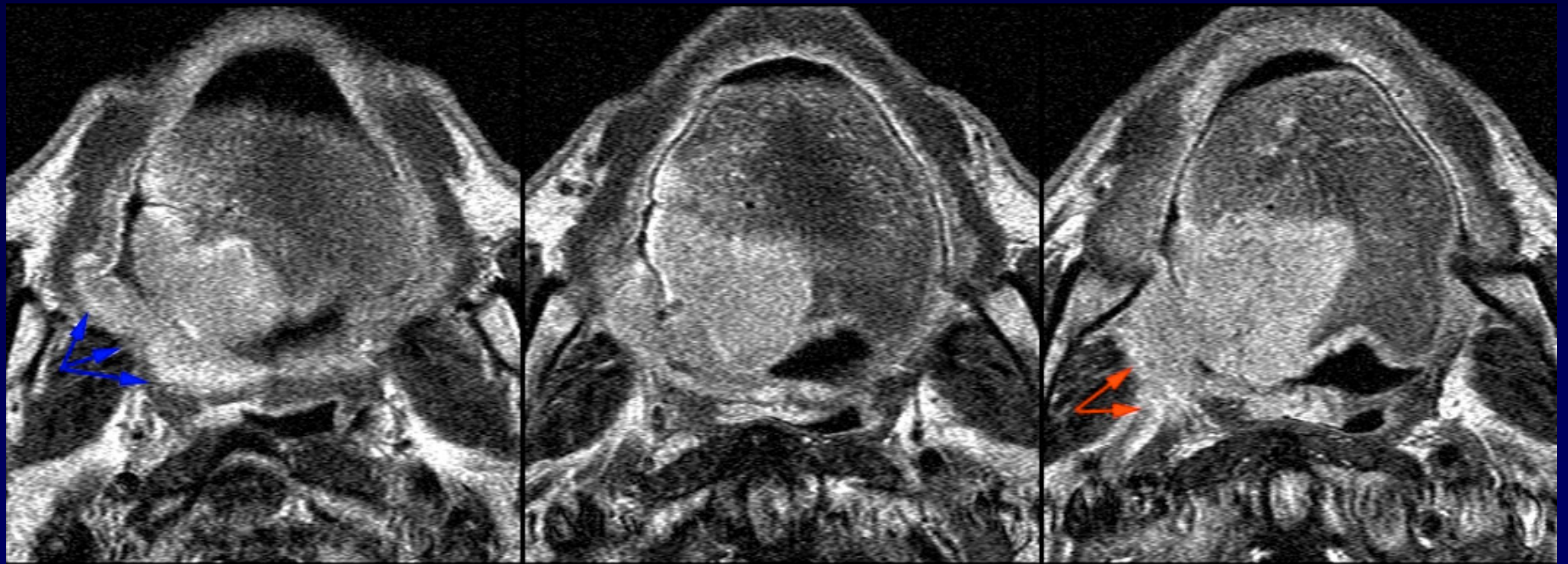














## Oropharyngeal SCC: mandibular involvement

	<b>OPG*</b>	<b>CT#</b>	<b>PET<sup>o</sup></b>	<b>SPECT*</b>	<b>MR</b>
<b>Sensitivity</b>	<b>50%</b>	<b>96%</b>	<b>95%</b>	<b>95%</b>	<b>93%</b>
<b>Specificity</b>	<b>94%</b>	<b>87%</b>	<b>48%</b>	<b>72%</b>	<b>93%</b>
<b>PPV</b>	<b>91%</b>	<b>89%</b>	<b>65%</b>	<b>79%</b>	<b>88%</b>
<b>NPV</b>	<b>63%</b>	<b>95%</b>	<b>93%</b>	<b>93%</b>	<b>96%</b>

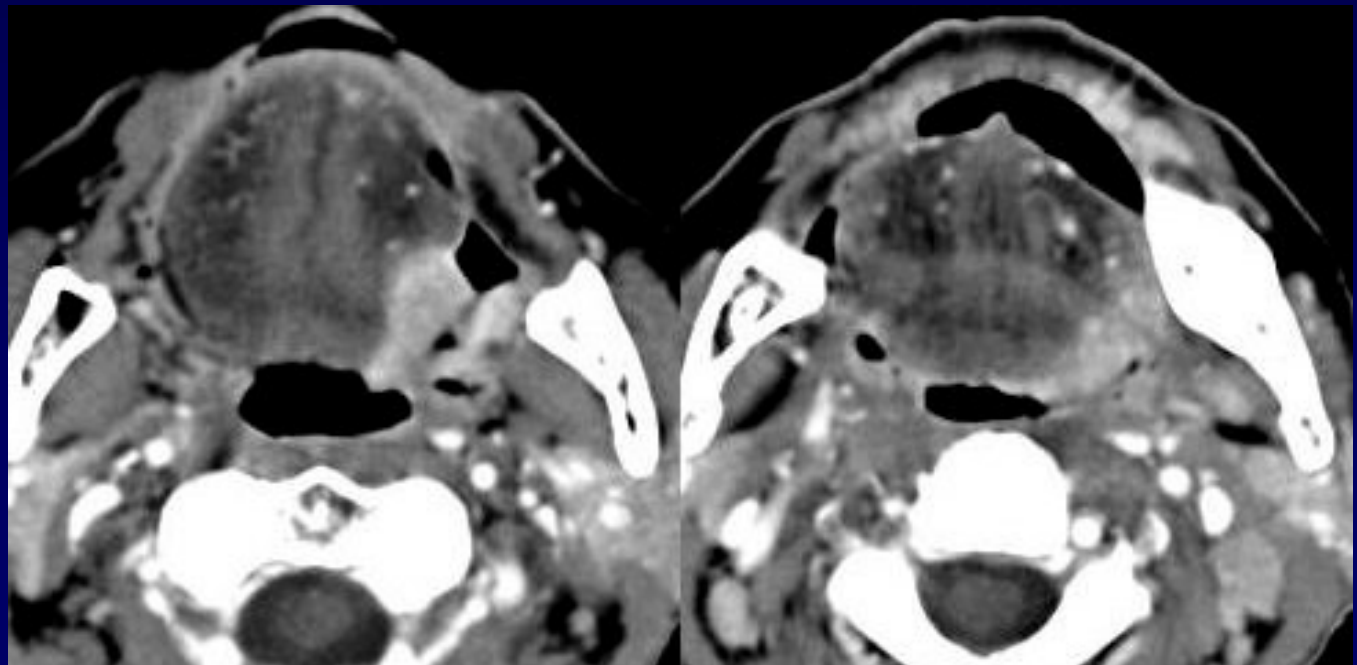
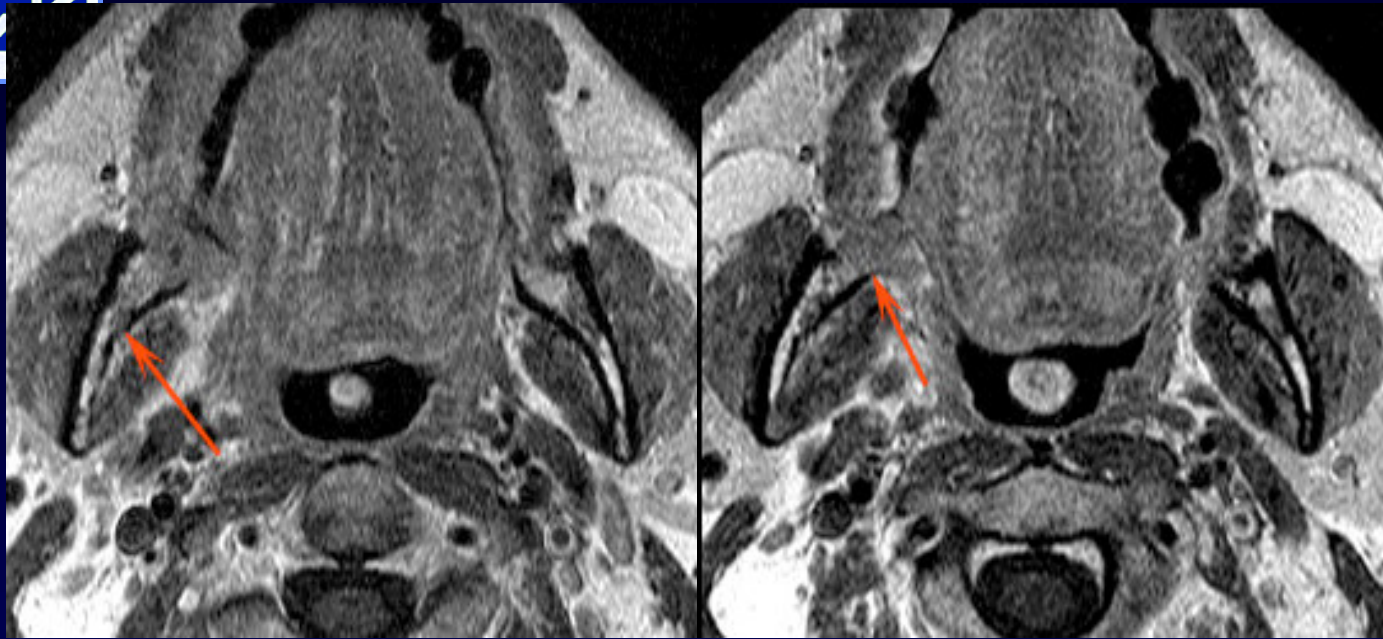
\* : Imola et al., Laryngoscope 2001

# : Mukherji et al., AJR 2001

o : Zieron et al., Head Neck 2001

^ : Bolzoni, Maroldi et al., Arch Otolaryngol Head Neck Surg 2004









## Question 2. ECS? Contra-lateral N+?

Evaluation of the impact of addition of PET to CT and MR scanning in the staging of patients with head and neck carcinomas

Hafidh, M. A., P. D. Lacy, et al. (2006). Eur Arch Otorhinolaryngol

- In conclusion, although PET has got a higher sensitivity in detecting nodal disease, it has only slightly improved the classification of N+ necks. The findings of this study cast doubt on the merit of routine addition of PET to the current investigative protocols for HNSCC patients.



## Question 3. Residual/Recurrent disease?

- Identify residual nodal/primary viable tumor after CT/RT
- Distinguish local recurrence from post-treatment changes
- Assess local extent
- F-FDG PET-CT > MR > CT



## PET for surveillance of head and neck cancer

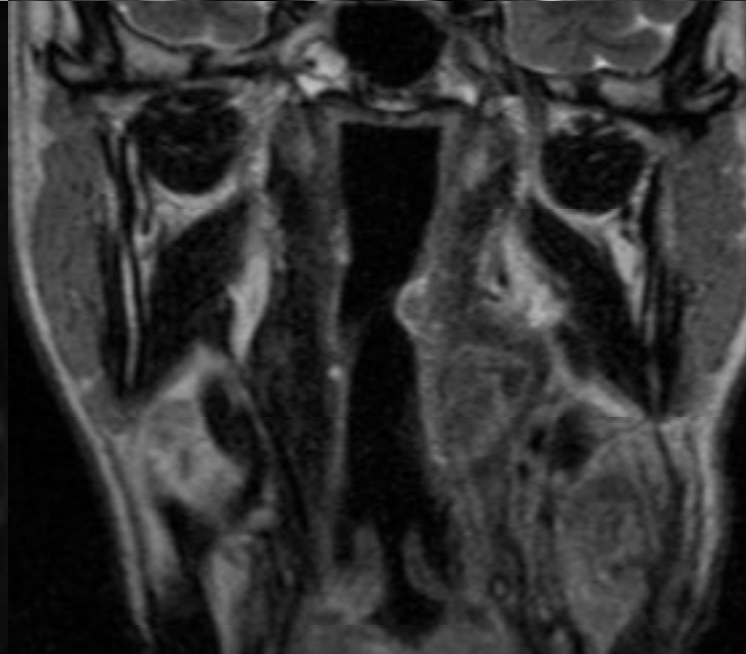
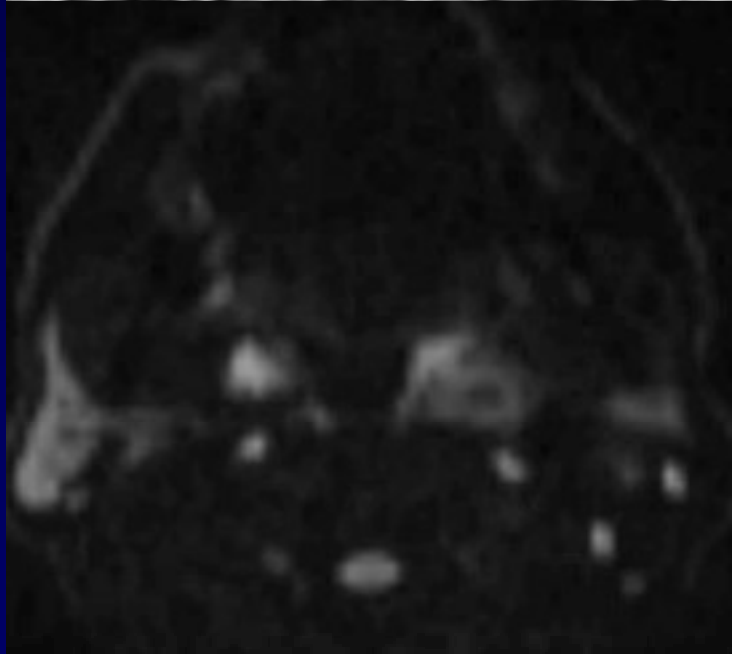
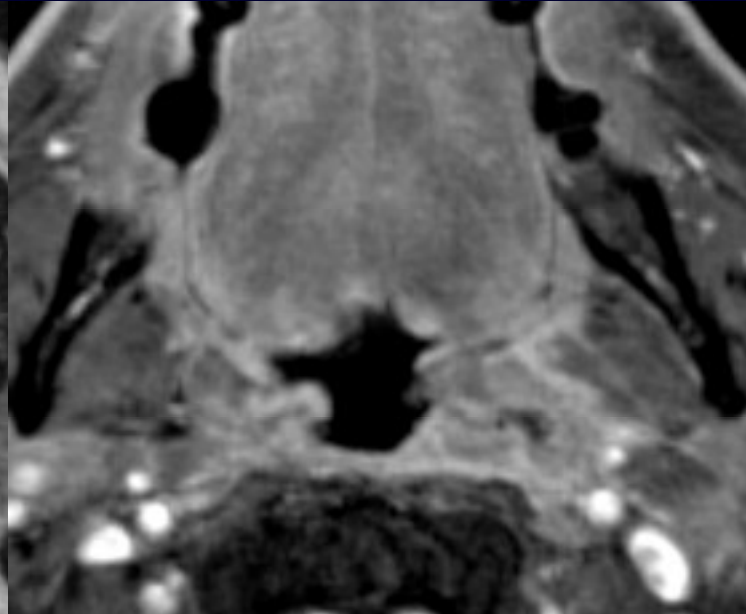
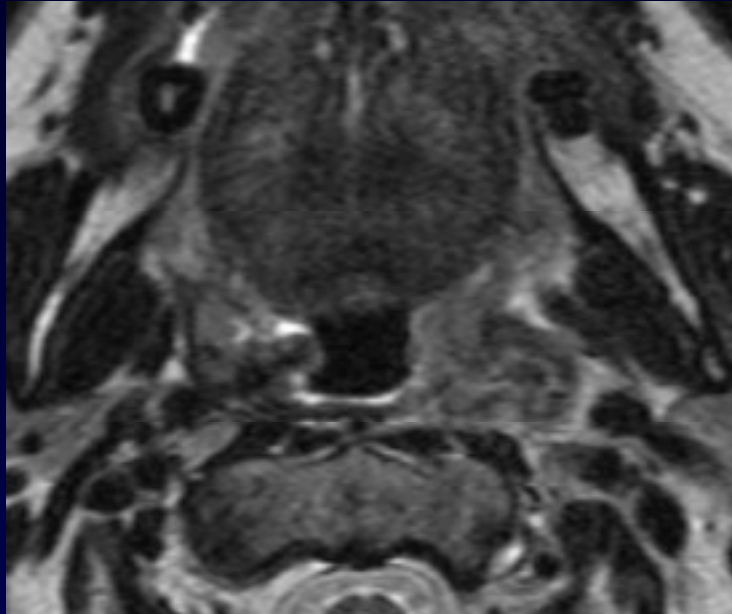
Ryan, W. R., W. E. Fee, Jr., et al. (2005). Laryngoscope 115(4): 645-50.

- 103 pts (HNSCC), 118 post-treatment PET
- We correlated PET results with surgical pathology and clinical outcome in the subsequent 6 months.
- locoregional persistent/recurrent SCC: PET SE 82%, SP 92%, **PPV 64%**, NPV 97%.
- detection of distant metastases, PET SE 89%, SP 97%, PPV 85%, NPV 98%.
- A negative PET is highly reliable for all sites. However, a positive PET in the head and neck region is unreliable because of a high false-positivity rate.



## PET-CT vs. c.e.CT after ChemoRT for advanced oropharyngeal SCC

- c.e. CT > accuracy in detecting disease at the primary site after treatment (85.7%).
- c.e. CT < accuracy for residual N+ (59.3% vs. 74.1%).
- For evaluating the neck, PET-CT and contrast-enhanced CT demonstrated 100% NPV, but the PPV was 36.3% and 26.6%, respectively.





## MR in the Postoperative Assessment of Oral-Oropharyngeal Cancer: Is There a Role?

- AHNS Annual Meeting 2006
- R. Maroldi; I. Moraschi; A. Bolzoni; P. Nicolai - University of Brescia, Italy
- 36 pts, mean f-up 38 mos, 121 MR exams, 19 rec in 16 pts
- SE 87.5%, SP 90%, **PPV 87.5%**, NPV 90%
- **4/8 rec** detected by MR first treated by salvage treatment
- **1/8 rec** detected by clinical examination had salvage surgery



## Summary

- Imaging precisely delineates the involvement of structures within & surrounding the oropharynx
- DWI-MRI may add important information to morphology-data obtained by “conventional” Imaging
- Sub-centimetric nodal metastasis is a challenge, DWI-MRI is promising