A Dosimetric Comparison of 3D Conformal Therapy and Volumetric Modulated Arc Therapy For Treatment of Nasopharyngeal Carcinoma

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Plan

1. Introduction;
2. Radiotherapy techniques for nasopharyngeal cancers;
3. A dosimetric comparison of 3D conformal therapy and volumetric intensity modulated arc therapy;
4. Conclusion;

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Introduction

- External radiotherapy plays a very important role in the treatment of head and neck cancers;
- Nasopharyngeal cancer is one of the most frequent forms of H&N cancers in the Maghreb;
- Particularly close to certain organs such as the spinal cord, the brainstem or even the parotid glands, this localization requires special attention in the choice of external radiotherapy treatment techniques;

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Introduction

- **Radiotherapy purposes:**
- **High radiation dose to tumor and areas at risk of invasion, for tumor control;**
- **A low dose to adjacent healthy tissue to avoid toxicities;**

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Plan

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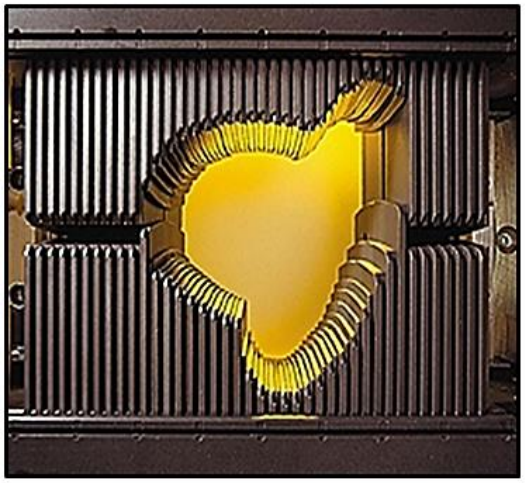
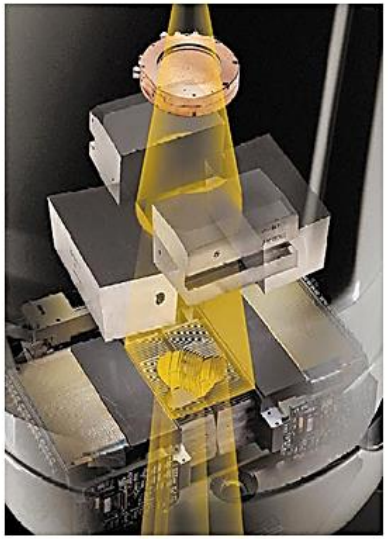
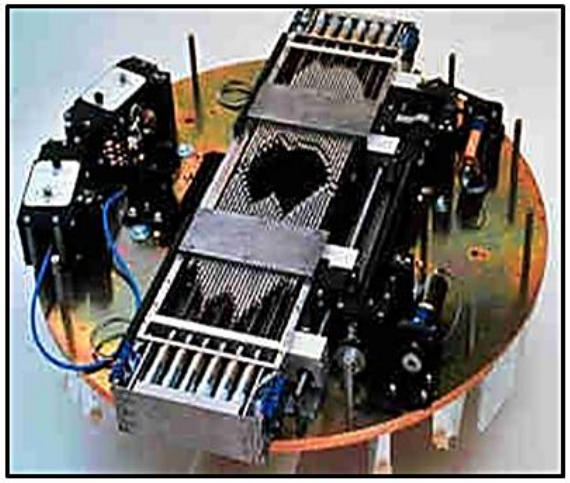
RT techniques for NPC

3D-CRT: Three-dimensional Conformal Radiotherapy :

- **Developed in the early 90s;**
- **Use multi-leaf collimators;**
- **The beams follow the shape of the target volume;**







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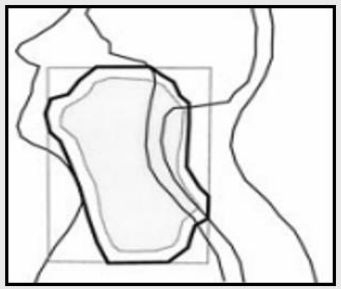
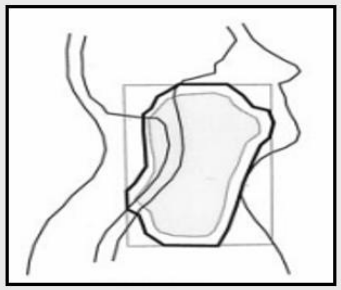
RT techniques for NPC

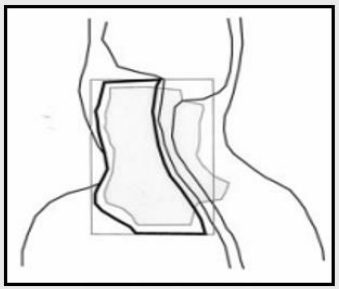
3D-CRT: Three-dimensional Conformational Radiotherapy :



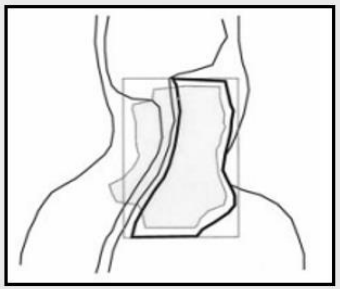
Left Lateral



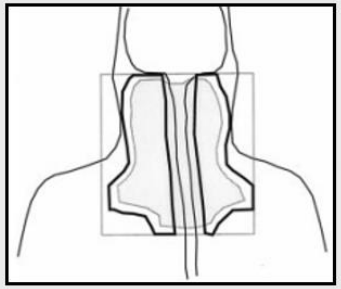
Right Lateral



Left Oblique Posterior



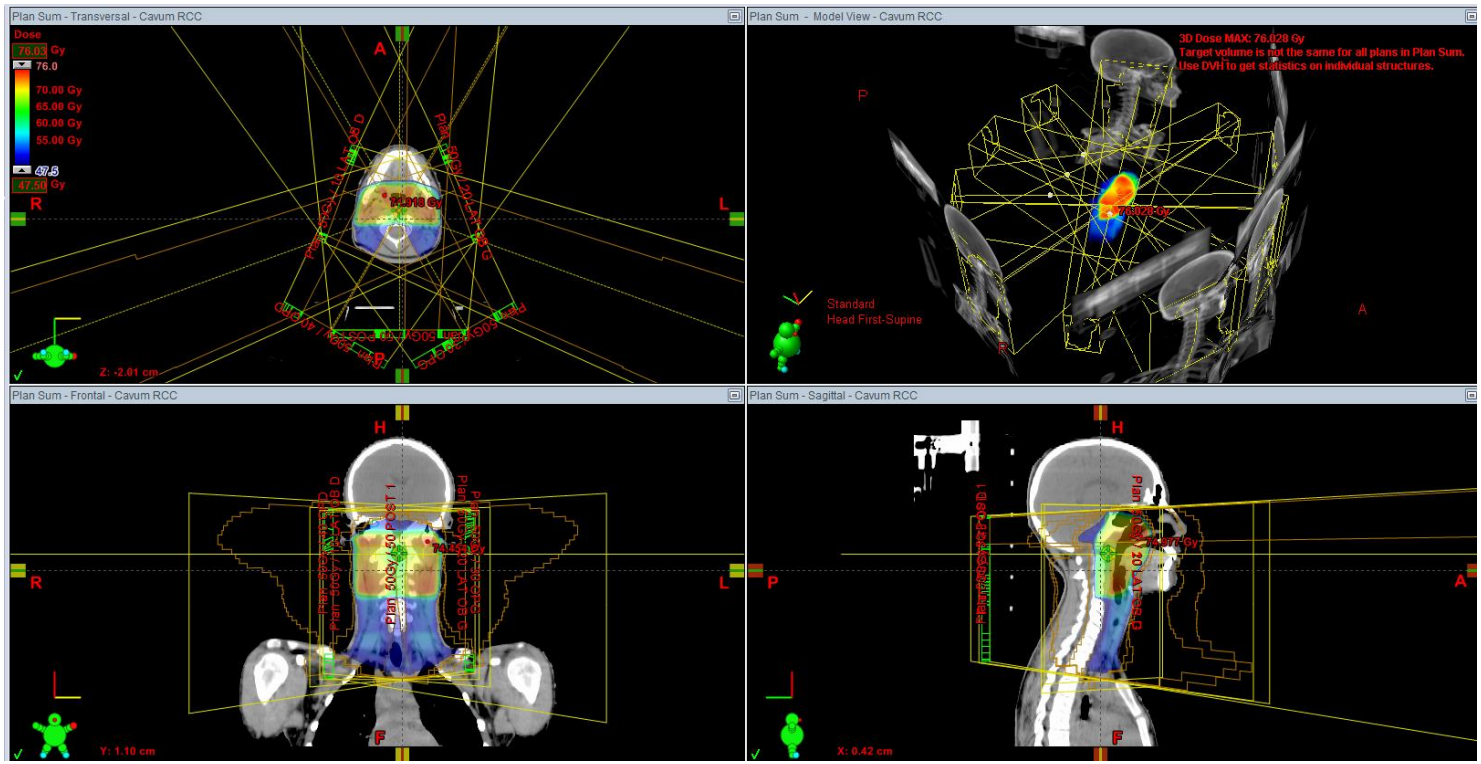
Right Oblique Posterior



Posterior

RT techniques for NPC

3D-CRT: Three-dimensional Conformational Radiotherapy :



RT techniques for NPC

V.M.A.T. **= Volumetric Modulated Arc Therapy**

- **A new intensity modultion tehcnique particularly intresting because it greatly reduces the duration of irradiation.**

- **In VMAT we vary at the same time :**
  1. **The position of the gantry and its speed of rotation;**
  2. **The position of leaf and their speed of movement;**
  3. **The dose rate;**

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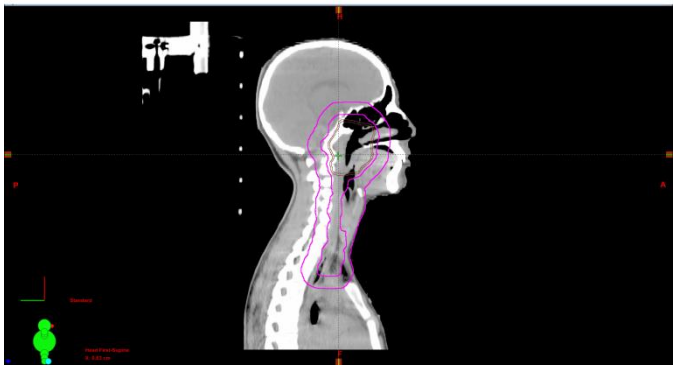
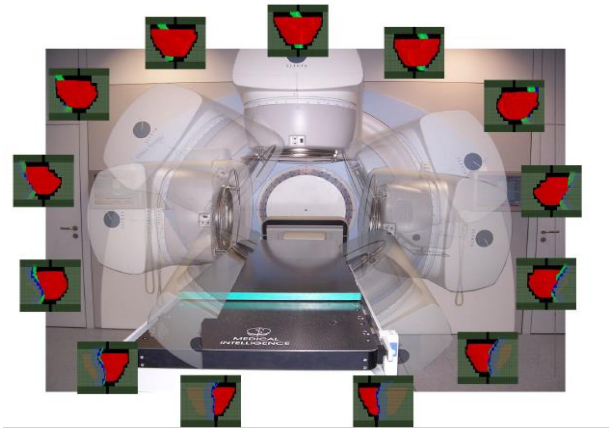
RT techniques for NPC

V.M.A.T. **= Volumetric Modulated Arc Therapy**

- **This technique is based on generation of aditionnal volues around the PTV in order to obtain a high dose;**

- **Plans consists of two full arcs (clockwise and counter clockwise with a delivery delay of 120 sec per arc;**





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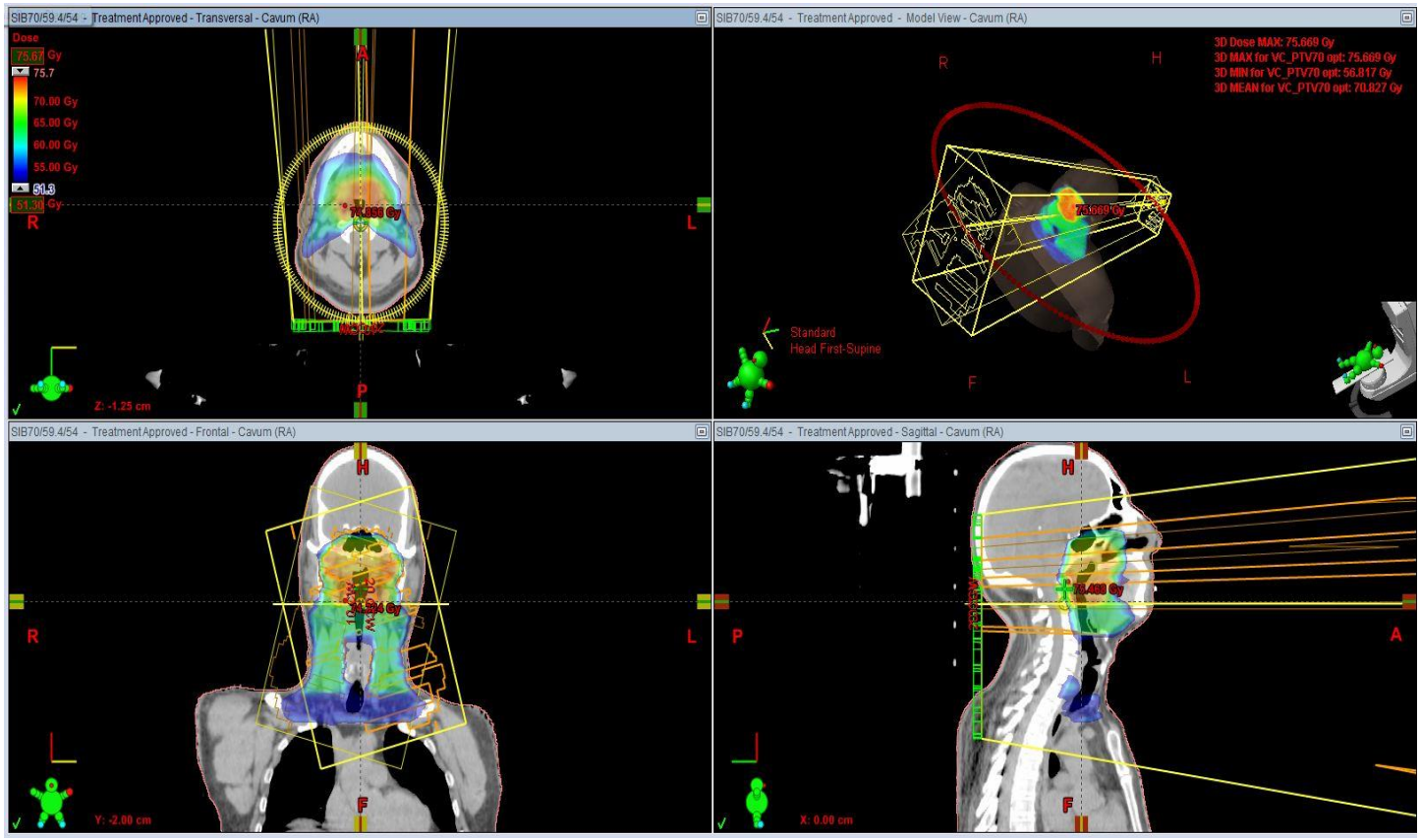
RT techniques for NPC

V.M.A.T. **= Volumetric Modulated Arc Therapy**



RT techniques for NPC

- The existance of two differents treatment techniques for the same localization implies asking several questions:

- What is the best technique that gives the patient precise treatment and a better quality of life ?
- Which technique gives the best dose coverage ?
- And which technique that most minimizes toxicity in OARs ?

- Our interest was in a dosimetric comparison between the two techniques

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3D-CRT vs VMAT for NPC

- **Methods:**

Patient characteristics:

- **10 patients NPC;**
- **Average age: 46 years;**
- **All patients received weekly concomitant chemotherapy treatment with cisplatine;**
- **Plans using both techniques:**
- **3D conformational in sequential in 35 sessions;**
- **VMAT SIB in 33 sessions;**

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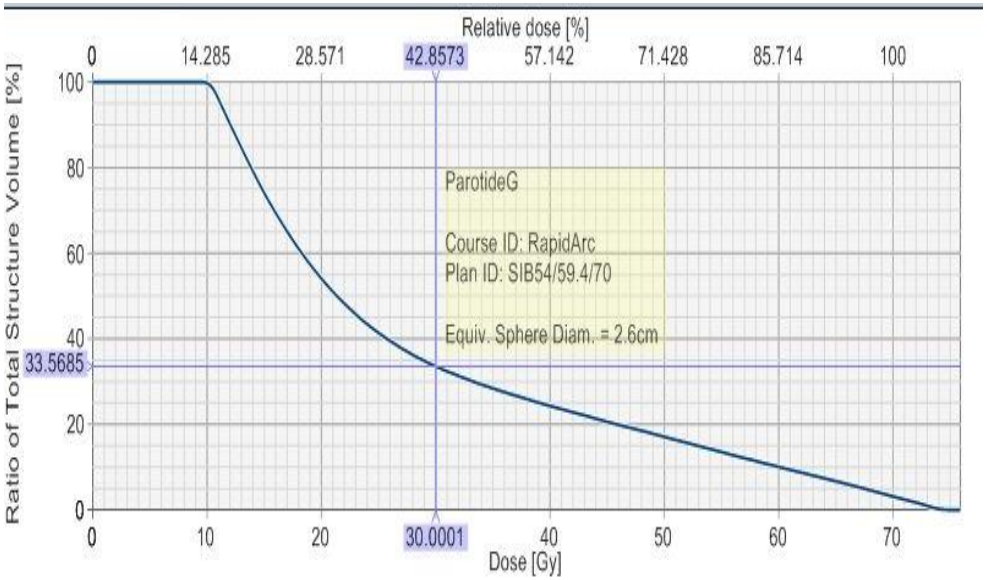
3D-CRT vs VMAT for NPC

- **Methods:**

1st comparison: using DVH



Brainstem Dmax < 54Gy

LPG V30< 50%

RPG V30< 50%

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3D-CRT vs VMAT for NPC

- **Methods:**
- **2nd comparison: calculation of different indexes :**
- **(Target Couvrage-TC-) :**

$$TC = \frac{V_{T,pi}}{V_T} \times 100$$

- **TC > 95 %, treatment plan is acceptable**

- **(Conformity Index-CI-):**

$$CI = \frac{V_{T,pi}}{V_{pi}}$$

- **CI =1**

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3D-CRT vs VMAT for NPC

- **Methods:**
- **2nd comparison: calculation of different indexes :**
- **Homogeneity Index-HI-):**

$$HI = \frac{D_{5\%} - D_{95\%}}{D_{mean}}$$

- **((Quality Index-QI-):**

$$QI = \frac{D^{VMAT}}{D^{3D-CRT}}$$

- **HI= 0**

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3D-CRT vs VMAT for NPC

- **Results:**

1st comparison using DVH:

Volume	VMAT	3D-CRT
Brainstem	49,69	58,55
LPG	36.94	100
RPG	38.55	100
PTV 50	98.65	97.42
PTV 70	96.44	93.23

- **GP FULLY irradiated with 3D-CRT**
- **Brainstem Dmax reduced with VMAT**
- **TV coverage almoste comparable**

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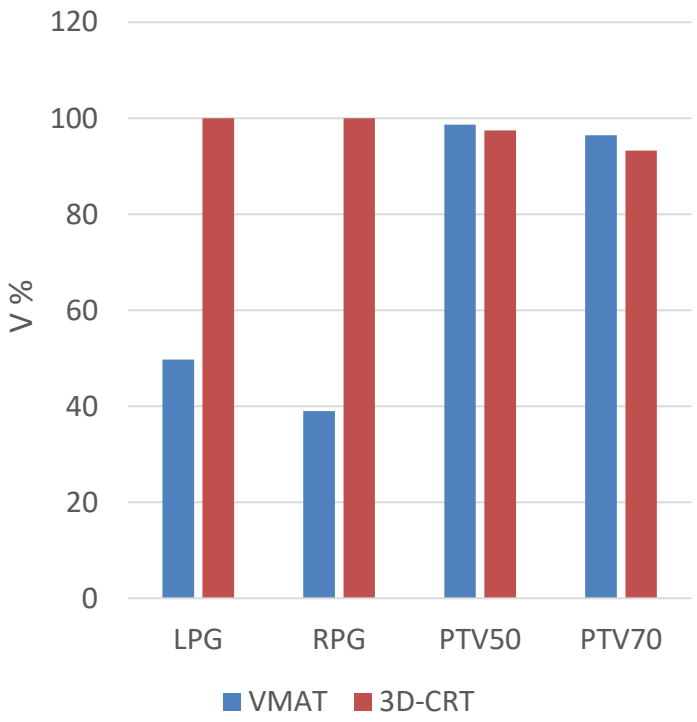
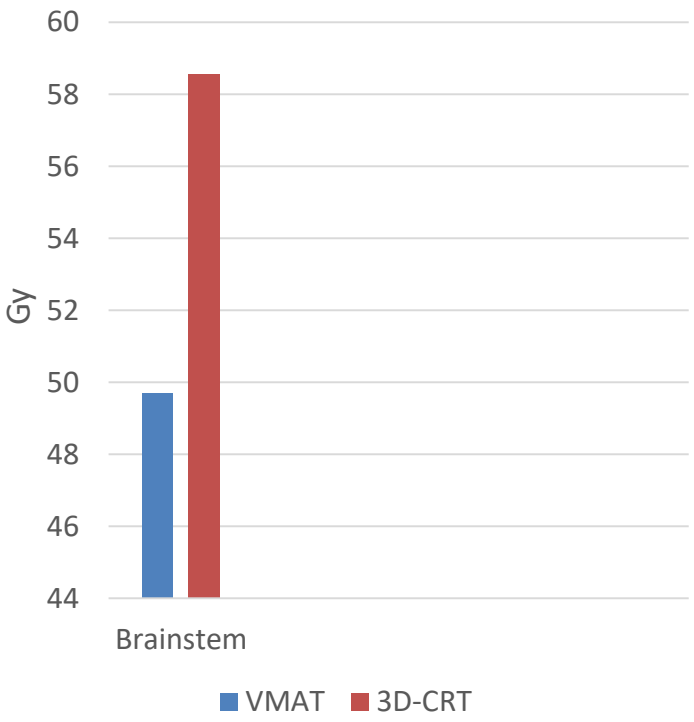
3D-CRT vs VMAT for NPC

- **Results:**

1st comparison using DVH:





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3D-CRT vs VMAT for NPC

- **Results:**

2nd comparison: calculation of diefferent indexes :

- **PTV 50:**

Index	VMAT	3D-CRT
TC	98.65	97,42
CI	0,65	0,4
HI	0,3	0,4

PTV 70:

index	VMAT	3D-CRT
TC	96,44	93,23
CI	0,89	0,49
HI	0,009	0,12

- **For both TV:**
  - TC VMAT > TC RTC-3D
  - CI VMAT > CI RTC-3D
  - HI VMAT < HI RTC-3D

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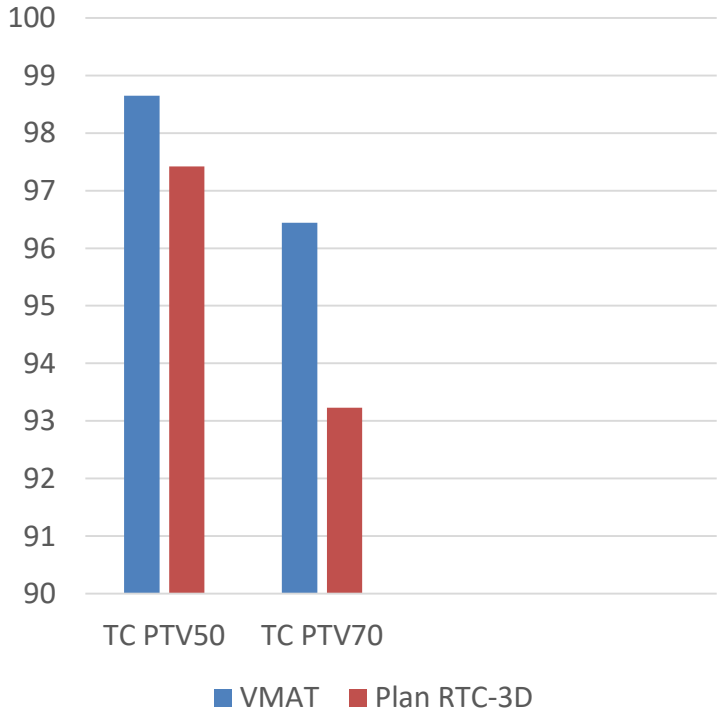
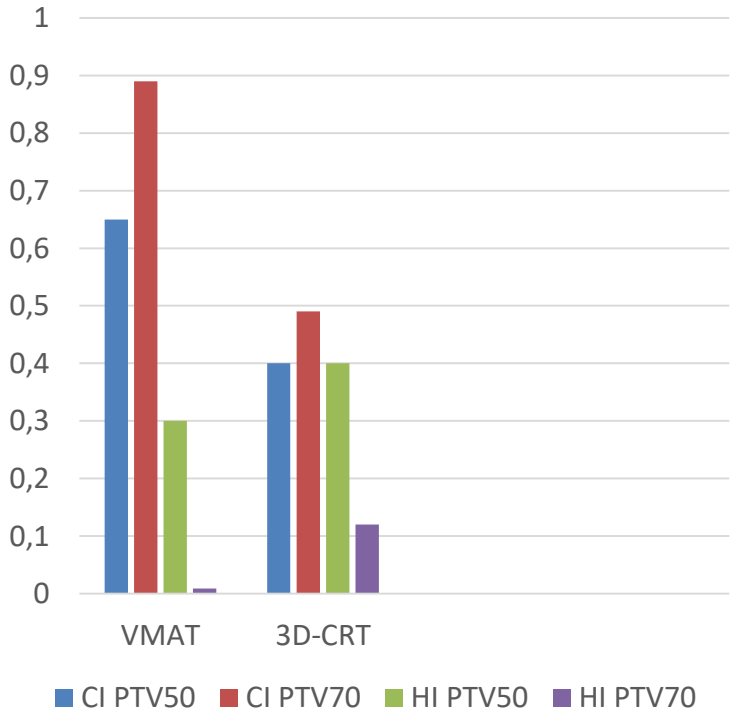
3D-CRT vs VMAT for NPC

- **Results:**

2nd comparison: calculation of differents indexes :





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3D-CRT vs VMAT for NPC

- **Results:**

2nd comparison: calculation of differents indexes :

- **Toxicity:**

	VMAT	3D-CRT	QI
Brainstem	49,69	58,55	0,84

QI < 1 VMAT less toxcic than 3D-CRT

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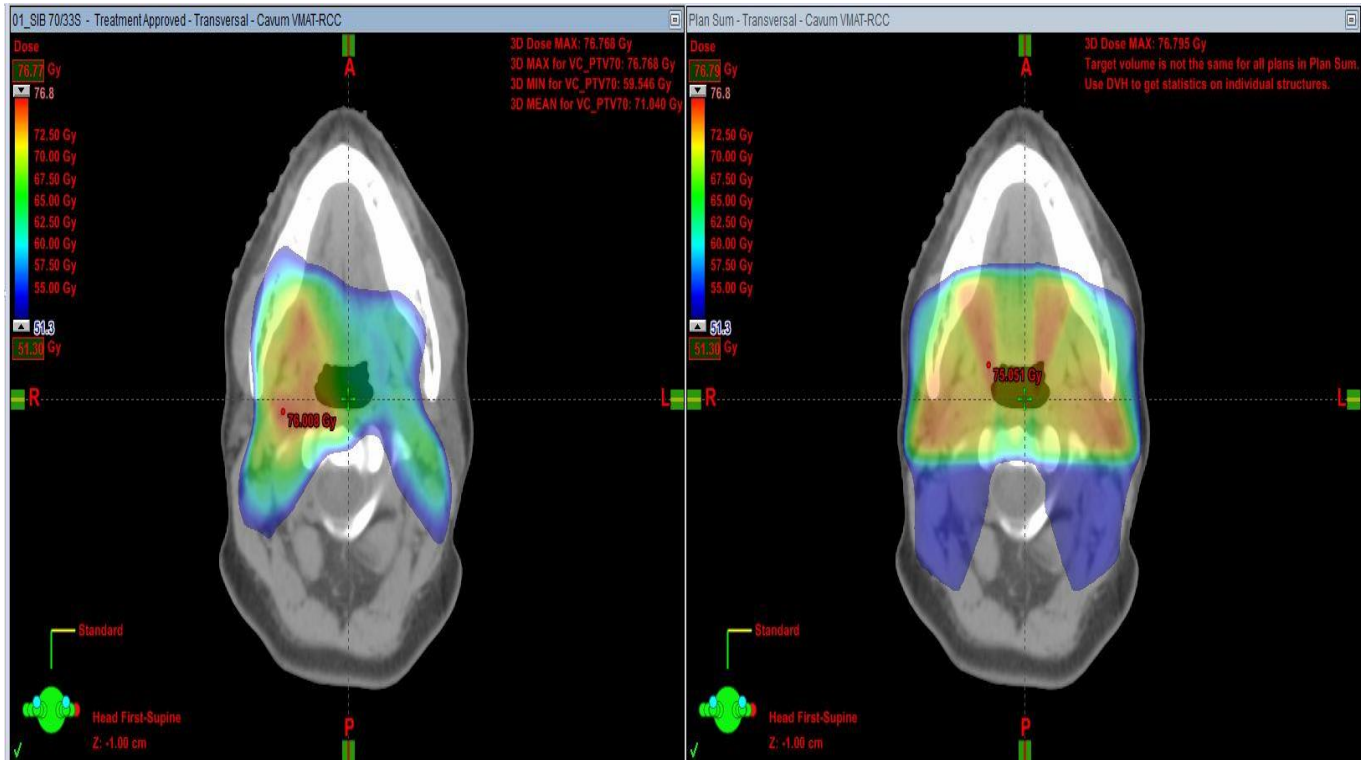
3D-CRT vs VMAT for NPC



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Discussion

- A significant dosimetric variation for the brainstem between to two plans;
- A significant preservation of the volumes of the two parotid glands using VMAT;

- The coverage of the target volume on DVH does not necessarily mean that the volume is well covered (confirmity index);

- The TC, CI, and HI are better in VMAT plans;
- The protection of OARs is best achieved with VMAT technique;

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Conclusion

- **VMAT technique in the treatment of NPC brings a significant gain in terms of:**

Local tumor control (TC++++)

Quanlity of life (toxicity----)

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Thank you