L'impatto dosimetrico e clinico del cambiamento dei volumi clinici su 18 pazienti con neoplasia avanzata del testa collo trattati con VMAT-Adaptive radiotherapy

NOULAS,L.LOREGGIAN,A.ROGGIO,F.TONETTO,A.TISATO,U.TEBANO,M.LEKAJ,M.PAIUSCO,L.CORTI

UOC DI RADIOTERAPIA E MEDICINA NUCLEARE

I.O.V – I.R.C.C.S.

PADOVA

Adaptive Radiation Therapy (ART)

"Adaptive radiotherapy" is defined as changing the radiation treatment plan delivered to a patient during a course of radiotherapy to account for

-Temporal changes in anatomy (e.g. tumor shrinkage, weight loss or internal motion)

- Changes in tumor biology/function (e.g. hypoxia).

Physics in Medicine and Biology

Deformable registration of the planning image (kVCT) and the daily images (MVCT) for adaptive radiation therapy*

Weiguo Lu[1], Gustavo H Olivera[1,2], Quan Chen[1], Kenneth J Ruchala[1], Jason Haimerl[1], Sanford L Meeks[3], Katja M Langen[3] and Patrick A Kupelian[3]

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ELSEVIER

Seminars in RADIATION ONCOLOGY

Adaptive Radiotherapy of Head and Neck Cancer

Pierre Castadot, MD, John A. Lee, Eng, PhD, Xavier Geets, MD, PhD, and Vincent Grégoire, MD, PhD, FRCR

Intensity-modulated radiation therapy (IMRT) in head and neck [illegible] the capability to generate steep dose gradients, leading to an impro[illegible] therapeu[illegible] index. IMRT plans are typically based on a pretreatment computed tom[illegible]raphy s[illegible] that provides a snapshot of the patient's anatomy. Nevertheless, interfractional patient variations may occur because of setup error and anatomical modifications. Therefore, the accuracy of IMRT delivery for H&N cancer may be compromised during the treatment course, potentially affecting the therapeutic i[illegible] this framework, adaptive radiotherapy is a potential solution, which consists of the explicit inclusion of the temporal changes in anatomy during the imaging, planning, and delivery of radiotherapy." Adaptive radiotherapy has brought an additional dimension to the management of patients with H&N cancer and has the potential to circumvent the adverse effects of positioning errors and anatomical changes. This article reviews the causes and discusses potential solutions to circumvent the discrepancies between the planned dose and the actual dose received by patients treated for H&N [illegible].

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International Journal of Radiation Oncology • biology • physics

Official Journal of the American Society for Radiation Oncology ASTRO

ntification of volumetric and geometric changes rring during fractionated radiotherapy for head-and- cancer using an integrated CT/linear accelerator em

l for poster discussion presentation at the 45th Annual Meeting of the American Society for Therapeutic y and Oncology, Salt Lake City, UT, October 19–23, 2003.

Bar[illegible], Adam S. Garden, M.D., K.Kian Ang, M.D., Ph.D., Jennifer C. O'Daniel, M.S., He D., Laurence E. Court, Ph.D., William H. Morrison, M.D., David I. Rosenthal, M.D., K.S.Clifford .D., Susan L. Tucker, Ph.D., Radhe Mohan, Ph.D., Lei Dong, Ph.D.

International Journal of Radiation Oncology • biology • physics

Official Journal of the American Society for Radiation Oncology ASTRO

Assessment of Parotid Gland Dose Changes During and Neck Cancer Radiotherapy Using Daily Megavo Computed Tomography and Deformable Image Registration

Choonik Lee, Ph.D., Katja M. Langen, Ph.D., Weiguo Lu, Ph.D., Jason Haimerl, M.S., Eri Ph.D., Kenneth J. Ruchala, Ph.D., Gustavo H. Olivera, Ph.D., Sanford L. Meeks, Ph.D., Patrick Kupelian, M.D., Thomas D. Shellenberger, M.D., D.M.D., Rafael R. Mañon, M.D.

Anatomical modifications and Dosimetric effects

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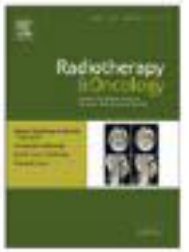

Adaptive RT in head and neck cancer

Adaptive functional image-guided IMRT in pharyngo-laryngeal squamous cell carcinoma: Is the gain in dose distribution worth the effort?

Pierre Castadot, Xavier Geets, John Alfred Lee, Vincent Grégoire

Department of Radiation Oncology, Université catholique de Louvain, Brussels, Belgium

QUESTIONI APERTE

- Clinical benefit of adaptive strategy will have to be evaluated both in terms of patients outcome and cost-effectiveness

- In the mean-time, owing to the complexity of the procedure, ART should not be used in routine clinical base

Castadot P. et al. Radiotherapy and Oncology.

International Journal of Radiation Oncology*Biology*Physics

Volume 85, Issue 1, 1 January 2013, Pages e47–e54

Clinical Investigation

Replanning During Intensity Modulated Radiation Therapy Improved Quality of Life in Patients With Nasopharyngeal Carcinoma

This work was presented in part at the 54th Annual Meeting of the American Association of Physicists in Medicine, Charlotte, NC, July 29-Aug 2, 2012. The manuscript received final approval from Hai-Hua Yang, Wei Hu, Wang Wei, Pei-Fang Chen, Weijun Ding, and Wei Luo.

Haihua Yang, MD*, Wei Hu, MD*, Wei Wang, BS*, Peifang Chen, BS*, Weijun Ding, MD*, Wei Luo, PhD†

Results

IMRT replanning had a profound impact on the QoL of NPC patients, as determined by statistically significant changes in global QoL and other QoL scales. Additionally, the clinical outcome comparison indicates that replanning during IMRT for NPC significantly improved 2-year local regional control (97.2% vs 92.4%, respectively, *P*=.040) but did not improve 2-year OS (89.8% vs 82.2%, respectively, *P*=.475).

Clinical outcomes among patients with head and neck cancer treated by intensity-modulated radiotherapy with and without adaptive replanning

Allen M. Chen MD*, Megan E. Daly MD, Jing Cui PhD, Mathew Mathai CMD, Stanley Benedict PhD and James A. Purdy PhD

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Issue

Head & Neck

Volume 36, Issue 11, pages 1541–1546, November 201

Three hundred seventeen patients underwent IMRT with daily image-guidance for newly diagnosed squamous cell carcinoma of the head and neck to a median dose of 66 Gy (range, 60–74 Gy). Of these 317 patients, 51 (16%) underwent adaptive radiotherapy with modification of the original IMRT midway during treatment.

Head & Neck
Volume 36, Issue 11, pages
1541–1546, November 2014

2-year OS

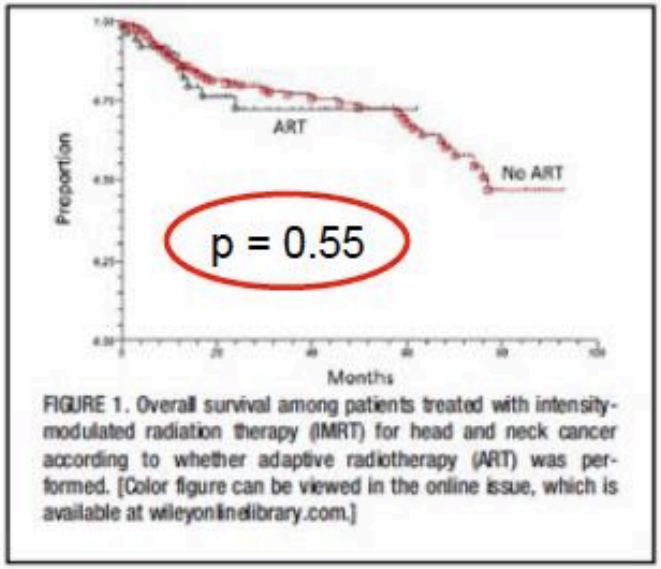


FIGURE 1. Overall survival among patients treated with intensity-modulated radiation therapy (IMRT) for head and neck cancer according to whether adaptive radiotherapy (ART) was performed. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

2-year LRC

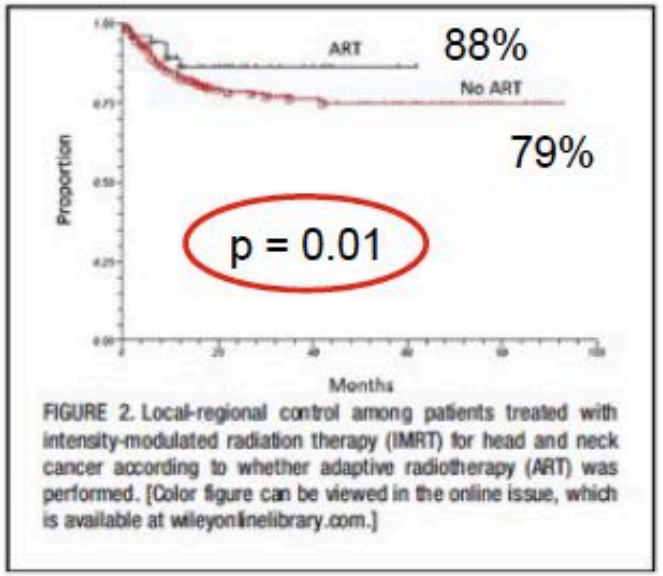


FIGURE 2. Local-regional control among patients treated with intensity-modulated radiation therapy (IMRT) for head and neck cancer according to whether adaptive radiotherapy (ART) was performed. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

The 2-year local-regional control was 88% for patients treated with adaptive replanning compared with 79% for patients treated without (p = .01). The median time to local-regional recurrence for the 4 patients treated by adaptive radiotherapy was 7 months (range, 3–15 months) with all failures occurring within the high-dose planning target volume (PTV).

La nostra esperienza

ADAPTIVE RADIOTHERAPY (A.R): RISULTATI DOSIMETRICI IN 10 PAZIENTI CON CARCINOMA DEL RINOFARINGE E DELL'OROFARINGE TRATTATI CON TECNICA VMAT

S. Noulas, L. Loreggian, A. Roggio, M. Paiusco, L. Corti
UOC di Radioterapia e Medicina Nucleare
I.O.V – I.R.C.C.S.

	Istologia	Sesso	Eta	Stadio	CT concomitante	Kg.persi	
	SCC	M	70	T3N2c	NO	16	
z	NPC	M	70	T3N1	SI	7	
3	SCC	F	67	T3N0	SI	7	
4	SCC	M	58	T2N2b	SI	14	
5	NPC	M	36	T2N1	SI	6	
6	NPC	M	63	T2N1	SI	5	
7	NPC	M	68	T3N2	SI	9	
8	NPC	F	69	T1N2	SI	4	
9	NPC	F	59	T2N2	SI	6	
0	NPC	M	40	T2N2	SI	10	
1	SCC	M	65	T2N2b	SI	5	
2	SCC	M	70	T3N1	SI	7	
3	SCC	M	57	T3N2c	SI	14	
4	SCC	F	61	T2N2b	SI	4	
5	SCC	F	47	T3N3	SI	13	
6	SCC	M	63	T1N2c	SI	8	
7	SCC	M	59	T2N2b	SI	5	

MATERIALI E METODI

- VMAT a 2 archi(360 gradi)
Varian Unique

-Pianificazione con Eclipse TPS

-5mm di margine per il PTV
66Gy-60-54/30f SIB per Orofaringe
69.9Gy-60-54/33f SIB per Rinofaringe

-TC settimanale di controllo

-Registrazione elastica con la TC di pianificazione
(Raystation TPS)

MATERIALI E METODI

-Follow up medio 14 mesi

-Follow up ogni 3 mesi per i primi 2 aa in ambito multidisciplinare

-Valutazione della risposta clinica con videolaringoscopia prima dell'inizio della RT e dopo 1 mese dalla fine del trattamento

-Prima valutazione radiologica 8 settimane dopo la fine del trattamento

MATERIALI E METODI

Valutazione della tossicita' acuta e tardiva

RTOG ACUTE Radiation Morbidity

Tissue	Grade 1	2	3	4
Skin	Follicular, faint or dull erythema / epilation / dry desquamation / decreased sweating	Tender or bright erythema, patchy moist desquamation / moderate edema	Confluent, moist desquamation other than skin folds, pitting edema	Ulceration, hemorrhage, necrosis
Mucous membrane	Injection / may experience mild pain not requiring analgesic	Patchy mucositis that may produce an inflammatory serosanguinous discharge / may experience moderate pain requiring analgesia	Confluent fibrinous mucositis / may include severe pain requiring narcotic	Ulceration, hemorrhage or necrosis
Eye	Mild conjunctivitis w/ or w/o scleral injection / increased tearing	Moderate conjunctivitis w/ or w/o keratitis requiring steroids and/or antibiotics / dry eye requiring artificial tears / iritis with photophobia	Severe keratitis with corneal ulceration / objective decrease in visual acuity or in visual fields / acute glaucoma / panophthalmitis	Loss of vision (uni or bilateral)
Ear	Mild external otitis with erythema, pruritus, secondary to dry desquamation not requiring medication. Audiogram unchanged from baseline	Moderate external otitis requiring topical medication / serous otitis media / hypoacusis on testing only	Severe external otitis with discharge or moist desquamation / symptomatic hypoacusis / tinnitus, not drug related	Deafness
Salivary gland	Mild mouth dryness / slightly thickened saliva / may have slightly altered taste such as metallic taste / these changes not reflected in alteration in baseline feeding behavior, such as increased use of liquids with meals	Moderate to complete dryness / thick, sticky saliva / markedly altered taste	(none)	Acute salivary gland necrosis
Pharynx & esophagus	Mild dysphagia or odynophagia / may require topical anesthetic or non-narcotic analgesics / may require soft diet	Moderate dysphagia or odynophagia / may require narcotic analgesics / may require puree or liquid diet	Severe dysphagia or odynophagia with dehydration or weight loss > 15% from pretreatment baseline requiring NG feeding tube, IV fluids, or hyperalimentation	Complete obstruction, ulceration, perforation, fistula
Larynx	Mild or intermittent hoarseness / cough not requiring antitussive / erythema of mucosa	Persistent hoarseness but able to vocalize / referred ear pain, sore throat, patchy fibrinous exudate or mild arytenoid edema not requiring narcotic / cough requiring antitussive	Whispered speech, throat pain or referred ear pain requiring narcotic / confluent fibrinous exudate, marked arytenoid edema	Marked dyspnea, stridor or hemoptysis tracheostomy or intubation necessary

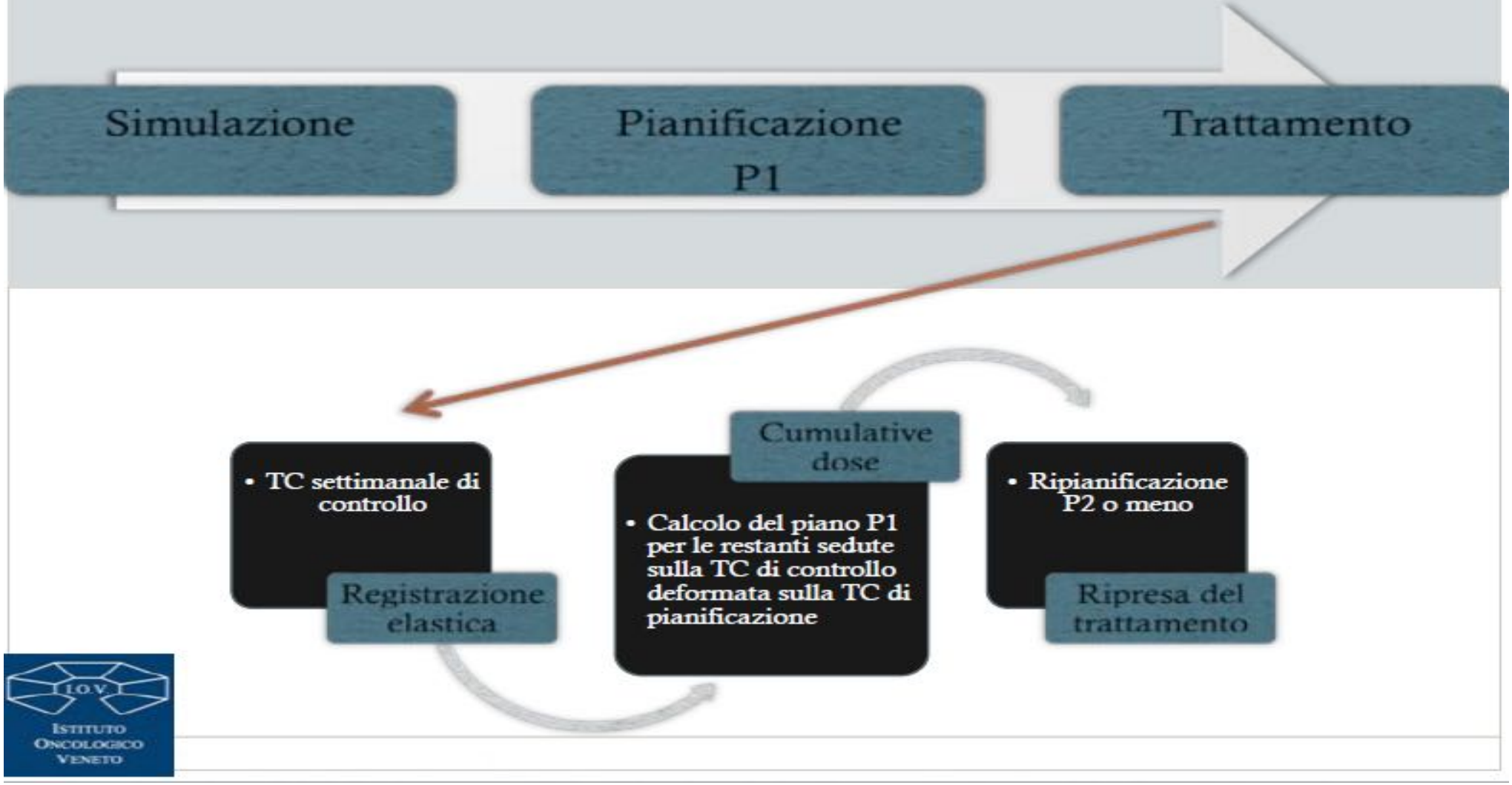
MATERIALI E METODI

Valutazione della tossicita' acuta e tardiva

RTOG/EORTC LATE Radiation Morbidity

Tissue	Grade 1	2	3	4
Skin	Slight atrophy; pigmentation change; some hair loss	Patch atrophy; moderate telangiectasia; total hair loss	Marked atrophy; gross telangiectasia	Ulceration
Subcutaneous tissue	Slight induration (fibrosis) and loss of subcutaneous fat	Moderate fibrosis but asymptomatic; slight field contracture; <10% linear reduction	Severe induration and loss of subcutaneous tissue; field contracture > 10% linear measurement	Necrosis
Mucous membrane	Slight atrophy and dryness	Moderate atrophy and telangiectasia; little mucous	Marked atrophy with complete dryness	Ulceration
Salivary glands	Slight dryness of mouth; good response on stimulation	Moderate dryness of mouth; poor response on stimulation	Complete dryness of mouth; no response on stimulation	Fibrosis

Workflow


Simulazione
Pianificazione P1
Trattamento
• TC settimanale di controllo
Registrazione elastica
Cumulative dose
• Calcolo del piano P1 per le restanti sedute sulla TC di controllo deformata sulla TC di pianificazione
• Ripianificazione P2 o meno
Ripresa del trattamento

RISULTATI

-10 pazienti sono andati incontro ad ART1

-Tempo medio tra TC e ART1 :1,9 giorni

-Media 1^ ripianificazione: 12^frazione

-6 pazienti sono andati incontro ad ART2

-Media 2^ripianificazione:20^frazione

RISULTATI

-Volume del CTV ad alto rischio diminuisce del ordine del 35% durante le prime 3 settimane di trattamento

-Volume medio parotideo diminuito dell 11%

-ART 1 riduce la dose media alle parotidi del 3,2%

-ART 2 nei casi Ca orofaringe riduce la dose media al cavo orale del 10%

RISULTATI/TOSSICITA' ACUTA

Acute side effects	Any Grade N	Grade 0 N/%	Grade 1 N/%	Grade 2 N/%	Grade 3 N/%	Grade 4 N/%
Skin	11	-	8(44)	7(39)	3(17)	-
Mucosal	18	-	9(50)	4(23)	5(27)	-
Salivary Glands	16	-	10(55)	6(34)	-	-
Faringo-esofageal	14	-	3(16)	7(39)	4(22)	-
Laryngeal	7	-	5(28)	2(11)	-	-

RISULTATI/TOSSICITA' TARDIVA

Late side effects	Any Grade N	Grade 0 N/%	Grade 1 N/%	Grade 2 N/%	Grade 3 N/%	Grade 4 N/%
Skin	7	-	7(39)	-	-	-
Mucosal	8	-	3(16)	5(27)	-	-
Salivary Glands	10	-	4(23)	6(34)	-	-
Faringo-esofageal	4	-	4(23)	-	-	-
Laryngeal	1	-	1	-	-	-

RISULTATI/ TOSSICITA' ACUTA

ADAPTIVE

Acute side effects	Any Grade N	Grade 1 N/%	Grade 2 N/%	Grade 3 N/%	Grade 4 N/%
Skin	11	8(44)	7(39)	3(17)	-
Mucosal	18	9(50)	4(23)	5(27)	-
Salivary Glands	16	10(55)	6(34)	-	-
Faringo-esofageal	14	3(16)	7(39)	4(22)	-
Laryngeal	7	5(28)	2(11)	-	-

NO ADAPTIVE

Any Grade N	Grade 1 N/%	Grade 2 N/%	Grade 3 N/%	Grade 4 N/%
18	4(20)	10(50)	4(20)	-
20	1(5)	11(27)	8(40)	-
19	8(40)	11(55)	-	-
15	4(20)	8(40)	3(15)	-
11	1(10)	10(50)	-	-

RISULTATI/ TOSSICITA' TARDIVA

ADAPTIVE

Late side effects	Any Grade N	Grade 1 N/%	Grade 2 N/%	Grade 3 N/%	Grade 4 N/%
Skin	7	7(39)	-	-	-
Mucosal	8	3(16)	5(27)	-	-
Salivary Glands	10	4(23)	6(34)	-	-
Faringo-esofageal	4	4(23)	-	-	-
Laryngeal	1	1(5)	-	-	-

NO ADAPTIVE

Any Grade N	Grade 1 N/%	Grade 2 N/%	Grade 3 N/%	Grade 4 N/%
10	10(50)	-	-	-
13	6(30)	7(35)	-	-
14	4(23)	10(50)	-	-
4	4(23)	-	-	-
5	5(25)	-	-	-

RISULTATI/ CONTROLLO LOCALE DELLA MALATTIA

-Con un follow up medio di 14 mesi abbiamo osservato una risposta parziale in 15% dei pazienti e una risposta completa nel restante 85% dei casi.

-Nessuna recidiva locale di malattia

-3 pazienti sono deceduti dopo la fine del trattamento (median survival =13 mesi)

CONCLUSIONI

-L’A.R. mostra un trend di riduzione della tossicita’ acuta e tardiva

-Non sembano esserci delle differenze nel controllo locale della malattia

-L’impatto clinico di questa tecnica deve essere ancora confermato da futuri trials.