Associazione Italiana Radioterapia e Oncologia clinica

Società Italiana di Radiobiologia

INTRABEAM IN PELVIC CANCER: THE EUROPEAN INSTITUTE OF ONCOLOGY EXPERIENCE

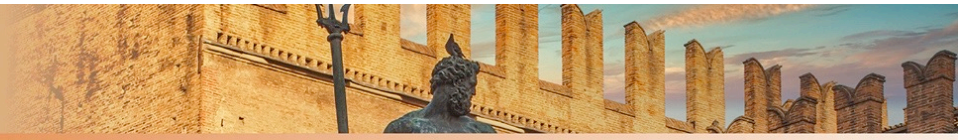
R. Lazzari, G. Corrao, **S. Durante**, S. Vigorito, F. Cattani, B.A. Jereczek-Fossa

UNIVERSITÀ DEGLI STUDI DI MILANO

Associazione Italiana Radioterapia e Oncologia clinica

Società Italiana di Radiobiologia

IEO Istituto Europeo di Oncologia

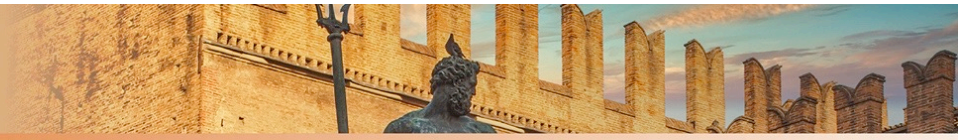


DICHIARAZIONE

Relatore: Stefano Durante

Come da nuova regolamentazione della Commissione Nazionale per la Formazione Continua del Ministero della Salute, è richiesta la trasparenza delle fonti di finanziamento e dei rapporti con soggetti portatori di interessi commerciali in campo sanitario.

- Posizione di dipendente in aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Consulenza ad aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Fondi per la ricerca da aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Partecipazione ad Advisory Board **(NIENTE DA DICHIARARE)**
- Titolarità di brevetti in compartecipazione ad aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Partecipazioni azionarie in aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Altro



- **BACKGROUND**
- **AIM**
- **MATHERIALS AND METHODS**
- **RESULT**
- **CONCLUSION**

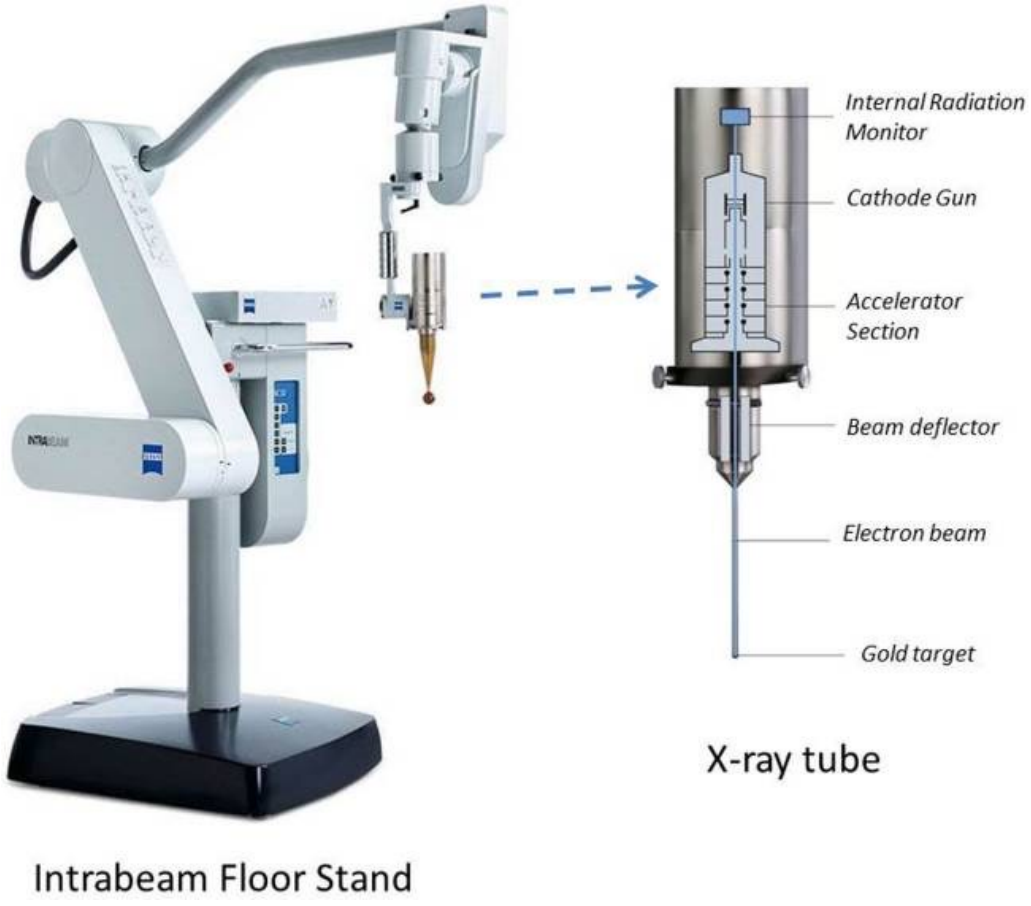
IORT: single high dose directly into the resected tumour volume in (semi) dedicated operating room

- HDR brachytherapy units
- Mobile electron facilities:

Mobetron (Siemens, Germany)

Novac7 (Hitesys SPA, It

- **Miniature X-ray source INTRABEAM®**



INTRABEAM™

• INTRABEAM™ Radiotherapy System (IORT) (Zeiss Surgical, Oberkochen Germany) has a miniature X-ray source at the end of a long 10-cm probe, 3.2 mm in diameter. At its end, the accelerated electrons strike a gold target resulting in a nearly isotropic X-ray distribution around the tip

• The miniature X-ray source delivers up to 50kV of energy to the target tissue, and the steep dose fall-off ensures that most of the dose stays in the target tissue. The decrease in radiation protects surrounding healthy tissue and minimizes shielding requirements.

• Because the X-ray are of low energy, no special wall, floor or ceiling shielding is required and the treatment can be carried out in conventional ORs, which normally have adequate shielding for intraoperative diagnostic radiology.

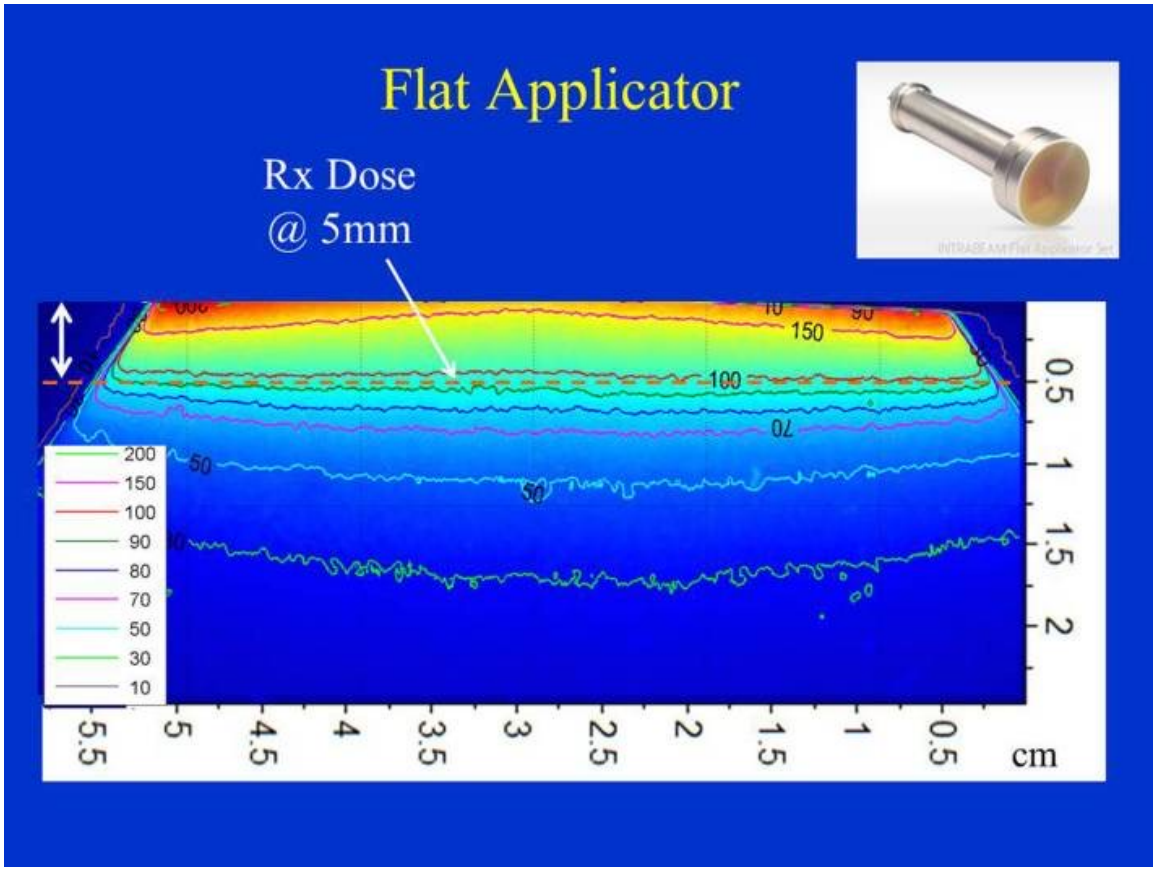
• A typical dose rate is 2Gy/min at 1 cm from the center of target

INTRABEAM Applicators

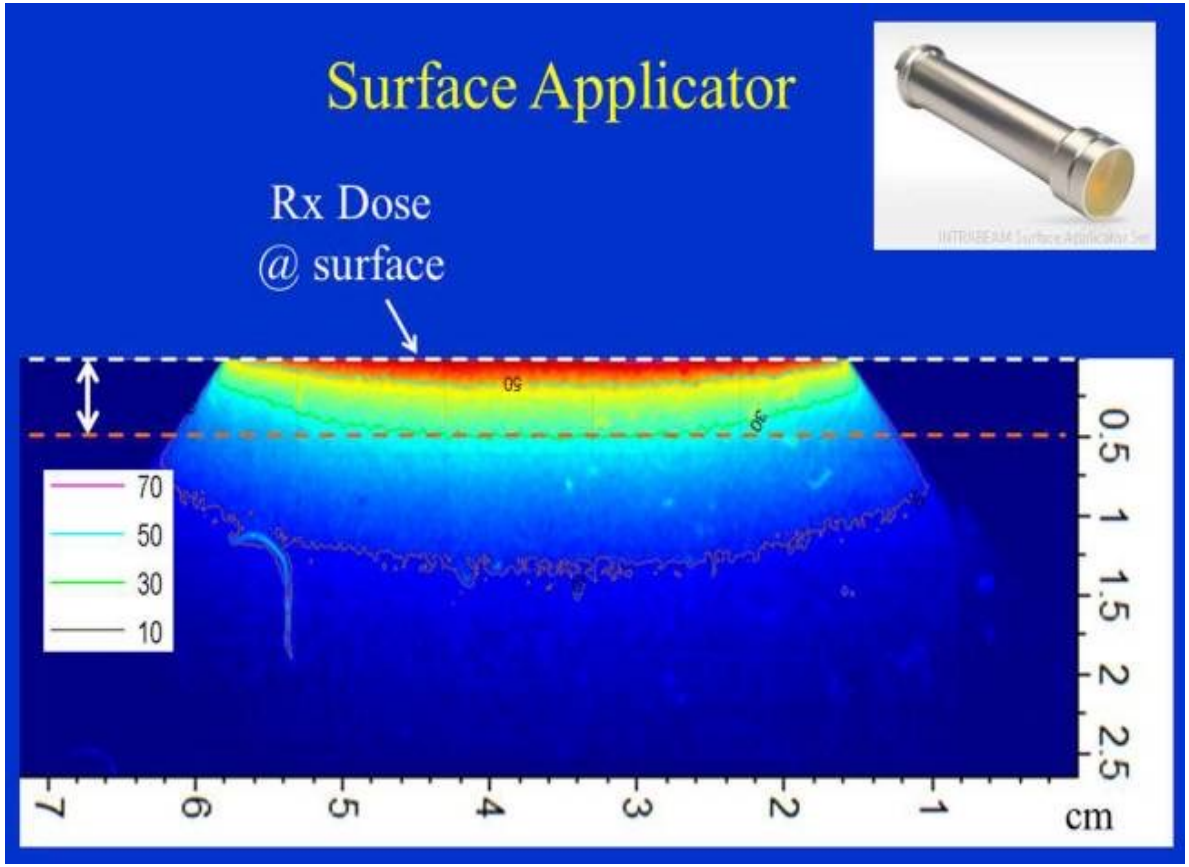
INTRABEAM
Flat Applicator

INTRABEAM
Spherical Applicator

INTRABEAM
Surface Applicator



- Dose uniformity (or flatness) perpendicular to the beam direction is greatest at the prescription depth of 5 mm with the dose being less uniform at other depths
- At shallower depths (<5 mm from the skin-surface), "horns" in dose profiles corresponding to higher dose values are seen at points away from the central axis
- Typical treatment time is approximately 30 min. Larger applicators require longer treatment times, but result in a lower surface dose (Ds) and superior dose-homogeneity
- Example: for a prescription dose of 10 Gy at 5 mm depth, 19.4 Gy would be delivered to the skin-surface corresponding to a dose-homogeneity



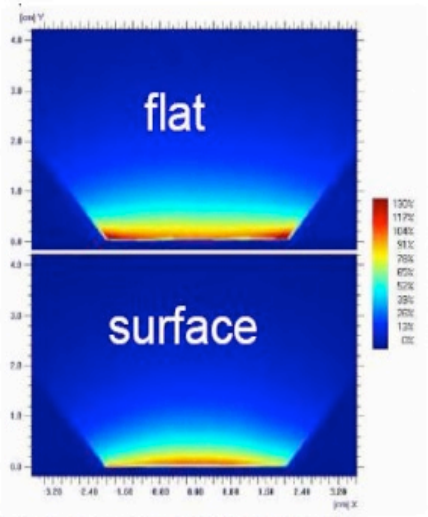
- The prescription dose is at the applicator surface and a rapid dose fall-off is observed with depth. The dose is highest along the central-axis and tapers off-axis.
- Larger diameter surface applicators will require longer treatment times but produce superior DH and lower Ds
- Example: for a prescription dose of 10 Gy at the applicator (or skin) surface, a treatment time of 4.5 min is required. This corresponds to a surface dose-rate (Ds) of approximately 2.2 Gy/min. At a depth of 5 mm, the dose reduces to only 3 Gy.

JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS, VOLUME 15, NUMBER 1, 2014

A novel approach for superficial intraoperative radiotherapy (IORT) using a 50 kV X-ray source: a technical and case report

Frank Schneider,[1a] Sven Clausen,[1] Johannes Thölking,[1] Frederik Wenz,[1] Yasser Abo-Madyan[1,2]

- Flat applicators
- Surface applicator



Prescribing 5 Gy in 5 mm tissue depth the treatment, using the flat applicators (1–6 cm), would last 5–30 min. To treat with 5 Gy at the surface of the surface applicators (1–4 cm), the dose rate curves can be extrapolated, resulting in a treatment time of approximately 0.5–3 min.

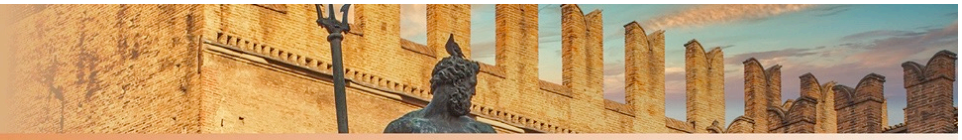
Guo et al. Radiation Oncology 2012, 7:110
http://www.ro-journal.com/content/7/1/110

RADIATION ONCOLOGY

RESEARCH Open Access

Intraoperative radiation therapy with the photon radiosurgery system in locally advanced and recurrent rectal cancer: retrospective review of the Cleveland clinic experience

Susan Guo[1], Chandana A Reddy[1], Matthew Kolar[1], Neil Woody[1], Arul Mahadevan[3], F Christopher Deibel[1], David W Dietz[2], Feza H Remzi[2] and John H Suh[1*]



IORT in NCCN Guidelines - Version 1.2022

Gynecological Cancer

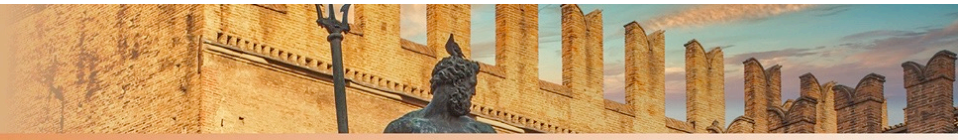
"IORT is particularly useful in patients with recurrent disease within a previously radiated volume. During IORT, overlying normal tissue (such as bowel or other viscera) can be manually displaced from the region at risk. IORT is typically delivered with electrons, brachytherapy, or miniaturized x-ray sources using preformed applicators of variable sizes matched to the surgically defined region at risk, which further constrains the area and depth of radiation exposure to avoid surrounding normal structures"

Rectal Cancer

"IORT, if available, should be considered for very close or positive margins after resection, as an additional boost, especially for patients with T4 or recurrent cancers"

Colon Cancer

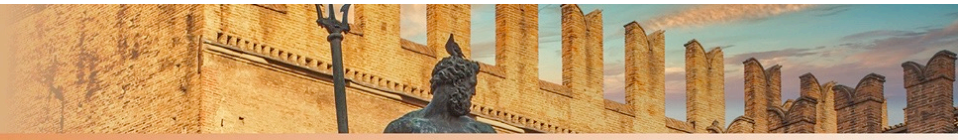
"Intraoperative radiation therapy (IORT), if available, should be considered for patients with T4 or recurrent cancers as an additional boost. Preoperative radiation therapy with concurrent 5-FU-based chemotherapy is a consideration for these patients to aid resectability"



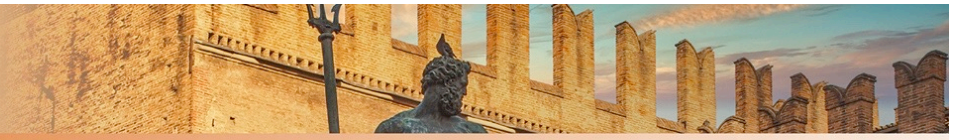
- BACKGROUND
- **AIM**
- MATHERIALS AND METHODS
- RESULT
- CONCLUSION

- To describe the experience at European Institute of Oncology with INTRABEAM™ Radiotherapy System (IORT) in a cohort of pelvic cancer patients

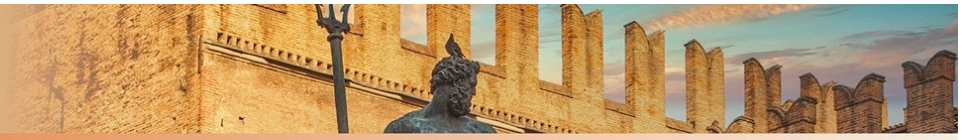
- To report outcomes and toxicities



- BACKGROUND
- AIM
- **MATHERIALS AND METHODS**
- RESULT
- CONCLUSION



- Retrospective monocentric study
- Patients with pelvic disease treated between May 2019 and March 2022
- Patients receive IORT boost with a 50 kV X-ray source using Intrabeam® RT delivery system (close or positive margin at the time of surgery)
- Local and distant relapses and survival were analyzed
- Acute and late toxicities were graded according to CTCAE 5.0 and RTOG criteria



- BACKGROUND
- AIM
- MATHERIALS AND METHODS
- **RESULT**
- CONCLUSION

- 18 consecutive patients (17 previously irradiated + 1 anticipated boost) and 22 lesions were treated

- Treated diseases: 8 cervical cancer, 2 vulvar cancer, 2 vaginal cancer, 4 rectal cancer, 2 pelvic lymph-nodes

- Applicator: Surface for 20 lesions, Flat for 2 lesions

- Applicator diameter 3-5 cm

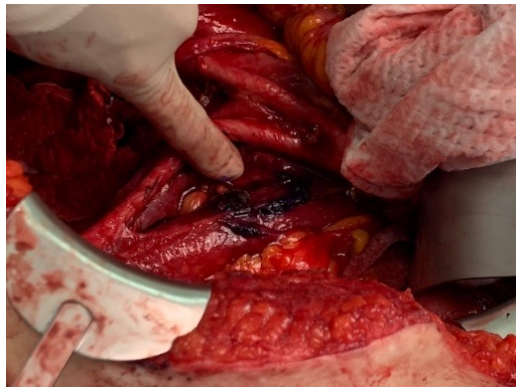
Dose (Gy)	Prescription Depth (mm)	Dose at the surface (Gy)
6	3	9
8	1	11.4
9	1	12
9.5	1	14
10	1	13
12	1	16
15	1	20

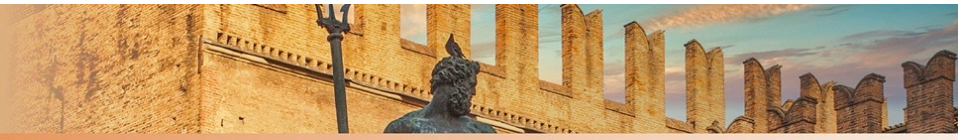
Median prescription dose: 9.5 Gy
Median depth of prescripion: 1 mm

At time of ananlysis:

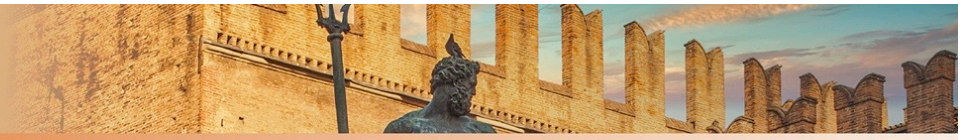
- 6 patients had no evidence of disease
- 7 patients had distant metastases
- 3 patients were lost at follow-up
- 2 patients had less than 6 months of follow-up.

Toxicity: None of the post surgical complications were correlated to IORT sites.





- BACKGROUND
- AIM
- MATHERIALS AND METHODS
- RESULT
- CONCLUSION



- Preliminary evidence from our study suggest that INTRABEAM is a feasible and manegeable IORT device in pelvic disease (hard-to-reach locations)
- Radiation protection benefits (minimized shielding requirements)
- Small diameter collimator, Better dose uniformity for surface treatments
- IORT had acceptable toxicity
- More and updated data are needed in order to draw robust conclusions


THANK
YOU
GRACIAS
ARIGATO
SHUKURIA
DANKSCHEEN
BIYAN
SHUKRIA
TINGKI
YAQHANYELAY
TASHAKKUR ATU
SUKSAMA
EKHMET
MEHRBANI
GRAZIE
MAAKE
KOMAPSUMNIDA
JUSPAXAR
GOZAIMASHITA
EFCHARISTO
BOLZÏN
MERCI
PALDIES
SPASSIBO
SNACHALHUYA
NUHUN
CHALTU
YUSPAGARATAM
NABEEJA
MAITEKA
HUI
GUI
HATUR
EKOJU
SIKOMO
MAKETAI
MIMMONCHAR
SPASIBO
DENKAUJA
NENACHALHYA
UNALCHEESH
MERSI
ATTO
DHANYABAAD
ANHA
LAH
SANCO
MERASTAWHY
GAEJTHO
TAVTAPUCH
MEDAWAGSE
AGUYJE
FAKAAUE
BAIKA