Quality assessment of Brachytherapy Treatment Plans – Two years experience –

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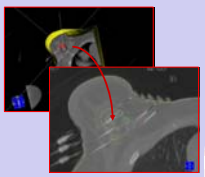
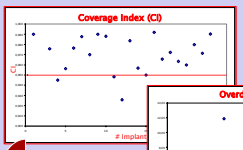
INTRODUCTION

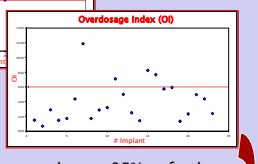
The purpose of this work is to present the results of two years experience (2004–2006) concerning the quality assessment of brachytherapy treatment plans based on dose–volume indexes.
The study regards three pathologies: gynaecology and breast (HDR) and prostate (LDR).

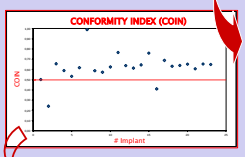
RESULTS

BREAST









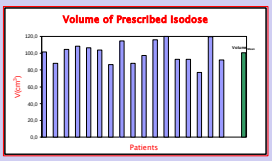
Target coverage above 95% of the prescribed dose is achieved in 79.2% of the cases.
The target volume that receives a dose higher than 2x the prescribed dose is kept bellow 6 cm³in 83.3% of the cases.

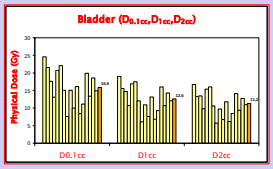
CONFORMAL TREATMENT PLANS HAVE BEEN ACHIEVED IN 77% OF ALL CASES.

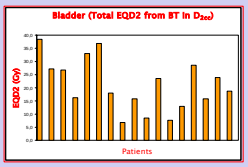
GYNAECOLOGY

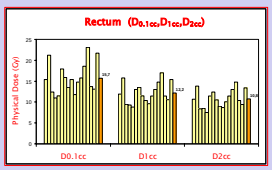
For every patient, the mean dose to points AA is equal to 14 Gy.

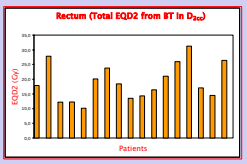
EQD2 is equal to, on average, 19.8Gy



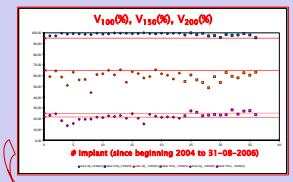


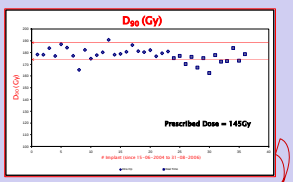






PROSTATE

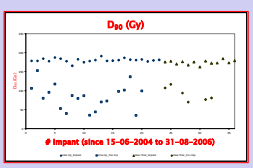


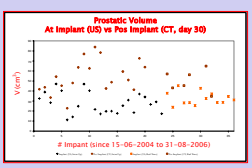


Clinical acceptance criteria concerning the prostate are mostly fullfilled.

For the rectum, and considering all the implants:
- The mean volume receiving 100% of the prescribed dose is 0.36cm³ (ranging from 0.00 to 3.05cm³)
- The mean volume receiving 69% of the prescribed dose is 1.56cm³ (ranging from 0.01 to 5.62cm³).

For the urethra, and considering all the implants:
- The dose received by the entire volume has been always bellow 220Gy.





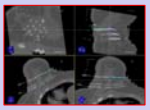
Discrepancies between dose–volume indexes evaluation were noted between implant and pos implant dosimetry.
The cause is directly related with the difference of the prostate volumes (US_implant vs CT_post implant).

METHODS AND MATERIALS

BREAST

The HOME MADE TEMPLATE

A microSelectron–TCS unit, Plato BPS, version 14.2.4., treatment planning system with Insight Module and the Comfort system, all from Nucletron, were used.
The template was home made[1].



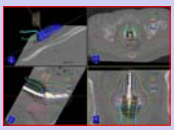
INSIGHT PLATO MODULE

IMPLANT

Assessment to:
- CI – Coverage index
- EI – External Index
- OI – Overdosage Index
- HI – Homogeneity index
- COIN=CI * (1–EI) – Conformity Index

Clinical acceptance criteria:
- CI ≥ 0.95
- OI must not exceed a percentage corresponding to a volume of 6cm³.
- COIN ≥ 0.60

GYNAECOLOGY



IMPLANT AND DOSE DISTRIBUTION

The implant is performed using the standard applicator.
The treatment is planned with Plato BPS, version 14.2.4, treatment planning system and is based on the CT scan acquired after the implant.
The bladder and rectum are drawn as organs at risk.
Dose prescription is done to points AA.

Gynaecologic patients receive 59.4Gy with external RT plus 2 brachytherapy treatments of 7 Gy each.

Assessment to:
For bladder and rectum,
- $D_{0.1cm^3}$, D_{1cm^3} e D_{2cm^3}
- V_{100} e V_{50}

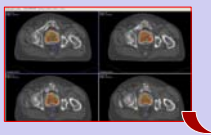
- Total dose to points AA
- Volume of the isodose through pts AA

Clinical acceptance criteria:
- Total dose delivered to points AA
- D_{2cm^3}

PROSTATE

COMBI

SEED LOADER



Two different techniques have been used: from the beginning 2004 until February 2006, intra–operative treatment planning using VariSeed (Varian) version 7.1 with rapidStrand 6711 Amersham seeds; since March 2006, real time planning using FIRST (Nucletron) system with Isotron loose seeds.

Pos–implant dosimetry is performed on day 30 after the implant based on CT images

Assessment to:
For Prostate,
- V_{200}, V_{150}, V_{100}
- D_{100}, D_{90}, D_{80}

For Rectum,
- V_{100}, V_{69}
- D_{2cm^3}, D_{5cm^3}

For urethra
- V_{100} and D_{100}

Clinical acceptance criteria:

For Prostate
- V_{100} ≥ 95%
- V_{150}<65%
- 22%<V_{200}<25%
- 120%<D_{90}<130%

For Rectum
- V_{100}<1cm³
- V_{69}<3cm³

For urethra
- D_{100}<220Gy

[1]: M. C.Lopes, C. Alves, M. Fragoso, "Quality assessment of image–based treatment planning of interstitial brachytherapy breast implants", GEC–Estro Brachytherapy meeting, Budapest (Hungary), 5–7 May 2005

CONCLUSIONS

- For each pathology, **clinical acceptance criteria are mostly fullfiled**:
  - Regarding breast patients, the treatment outcome is quite satisfactory. There is only one patient which persists with skin complains.
  - In what concerns prostate patients, and despite the short follow up, **there is no clinical correlation between D_{90} at the time of pos implant dosimetry and treatment outcome**.
    D_{90} values at the time of pos implant dosimetry are considerably lower than at the time of implant. The reason is directly related with prostatic volume evaluation with CT (pos implant) vs with US (implant).
    The results are nevertheless consistent with other published results.
  - Considering the whole treatment (EBRT+BT) for the gynaecologic patients, the total EQD2 to points AA is, on average, 77.8 Gy, then within recommended values. For the rectum and bladder, mostly due to the total dose administered with external radiotherapy, the total EQD2 is equal to, on average, respectively 76 Gy and 78.1Gy.
- The adopted metodologies for brachytherapy implants **accomplish the international reccomendations** for modern brachytherapy techniques.
- The calculation and report of dose–volume indexes **allow the assessment of treatment plan quality** and turn out the changing of practices with confidence.
- The **correlation with treatment outcome has been reinforced** and a more consistent follow up of patients is being implemented.

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