

6th ALATRO Congress – Punta Cana – November 2017

Accreditations in Radiotherapy

Equal-Estro Experience with Dosimetry Audits of Cyberknife Systems

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- no conflict of interest

Summary

- **Equal-Estro Laboratory**
- **Materials & Methods for external-QC of Cyberknife systems**
 - **Phantoms**
 - **Dosimeters**
 - **Protocol**
- **Tests & Outcomes**
- **Discussion & Conclusion**

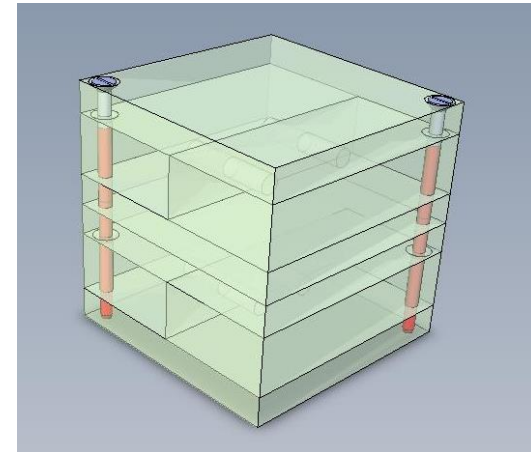
Equal-Estro Laboratory

- **based near Paris, in Villejuif, France**
- **accredited since 2004 by the French authorities for mandatory QC in radiotherapy**
 - **about 700 standard therapy beams are tested each year**
- **+ voluntary audits in:**
 - **brachytherapy**
 - **image reconstruction tests**
 - **dosimetry tests**
 - **advanced techniques of radiotherapy**
 - **IMRT**
 - **VMAT**
 - **Tomotherapy**
 - **Cyberknife**

Materials and Methods

Phantoms :

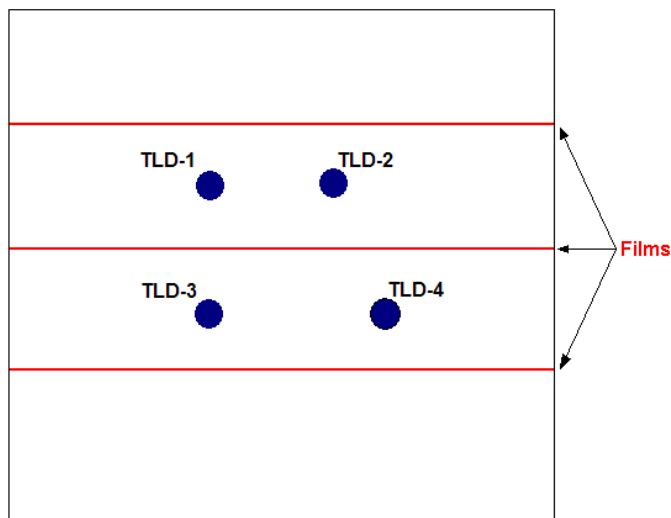
- Anthropomorphic head phantom designed for end-to-end tests
 - water-equivalent plastic phantom, “MiniCube” , (*)
 - 4 TLD capsules and 3 films can be placed inside.



**Schema of the “Minicube” phantom
(transparency is only virtual)**

(*) Guinement L. & all., *Cancer Radiother.* 2013; 17(4): 288

Materials and Methods



- the films are positioned in coronal planes
- TLDs are axially oriented

Materials and Methods

Detectors :

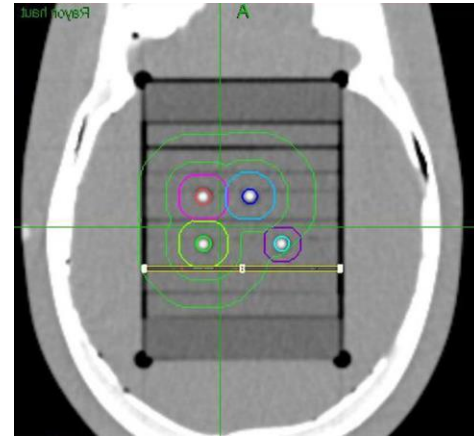
- Thermoluminescent detectors,
 - TLD-700[®] powder, Harshaw
 - active volume: 3mm diam. x 20mm length
 - 4 TLDs are irradiated in dynamic mode
 - + 2 TLDs in static mode (ref. cond.)
- Gafchromic films, EBT-3[®], Ashland
 - active square size 50mm
 - 3 films are irradiated for each test



Materials and Methods

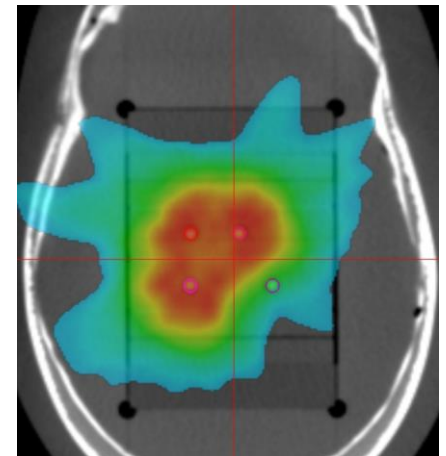
Summary of the irradiation protocol :

- ❑ PTV (TLD) defined as the
3 TLD outlines on the CT scan
+ a 6mm margin
- ❑ PRV (OAR) defined as the
4th TLD outline
+ 6mm margin



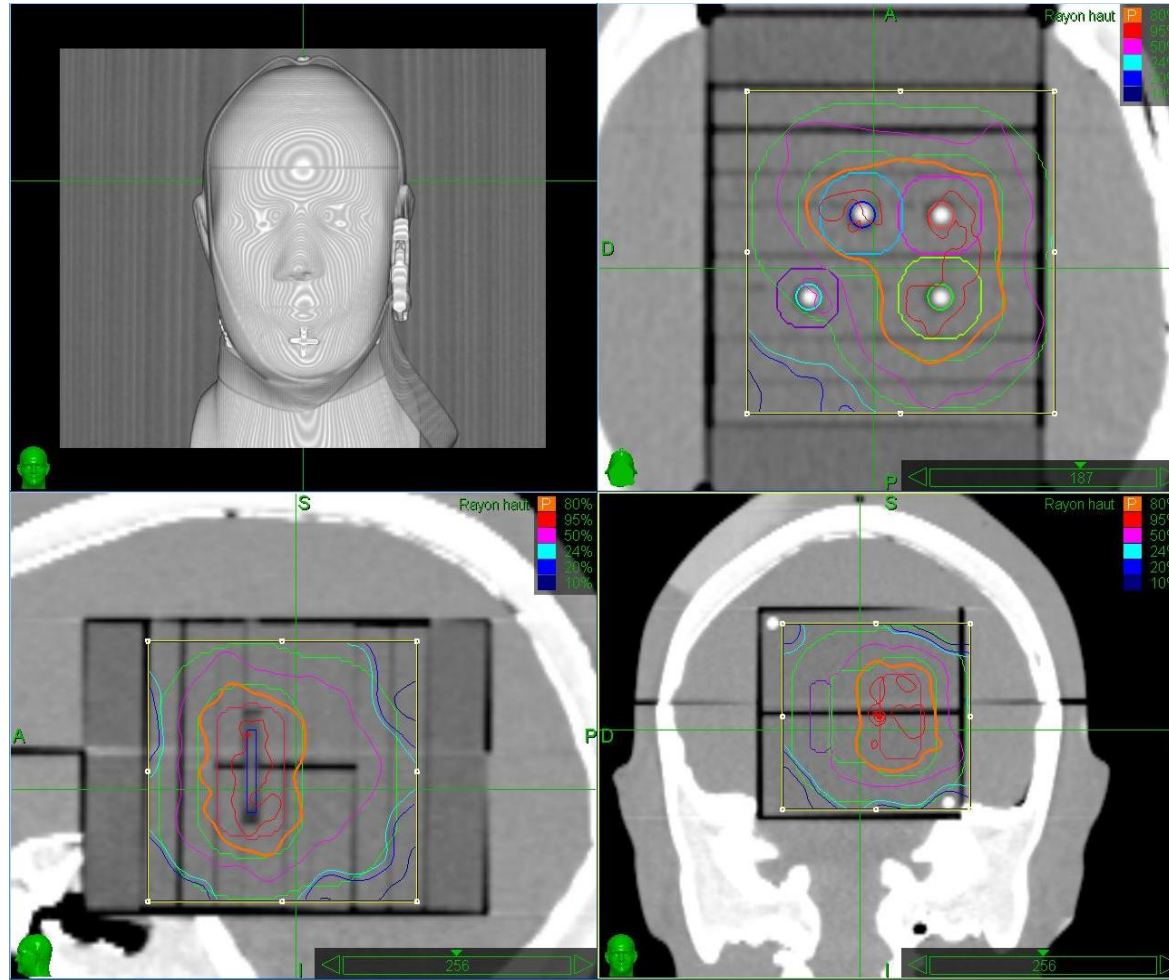
Optimization constraints :

- PTV : prescription : ~3.3Gy @ 80%, 4.0Gy max
- OAR : lower than half of the prescription
- 6D-Skull tracking (head-phantom skull)
- Irradiation in a single fraction
- Measured dose compared to calculated dose:



Materials and Methods

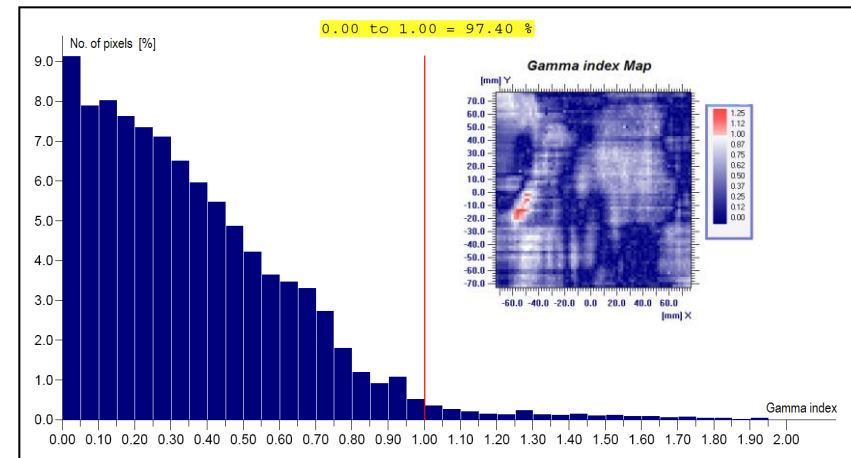
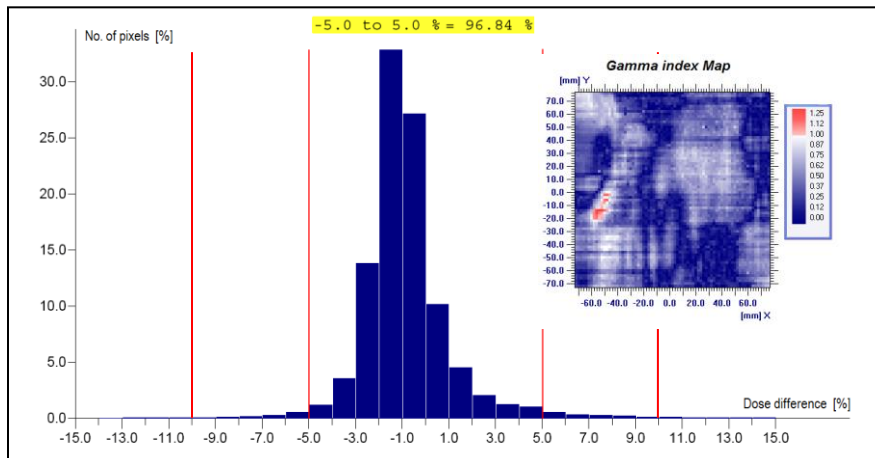
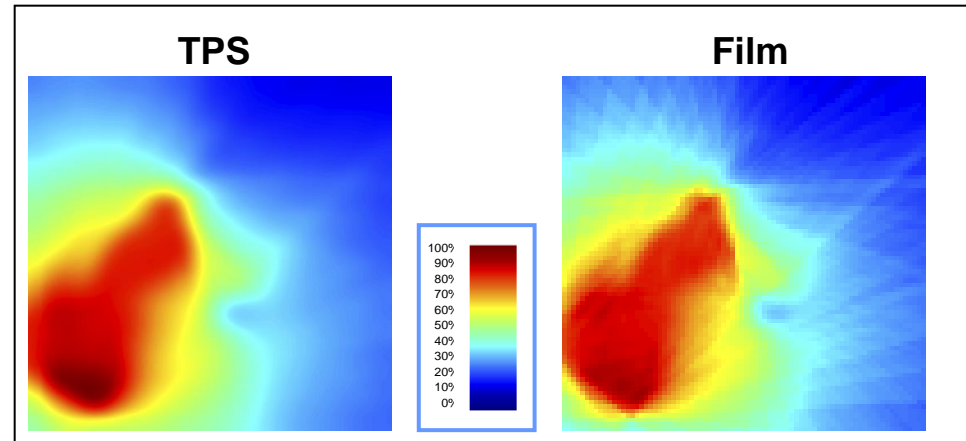
Example of dose distribution (122 beams, 4036 MU)



Materials and Methods

- **Acceptance criteria :**

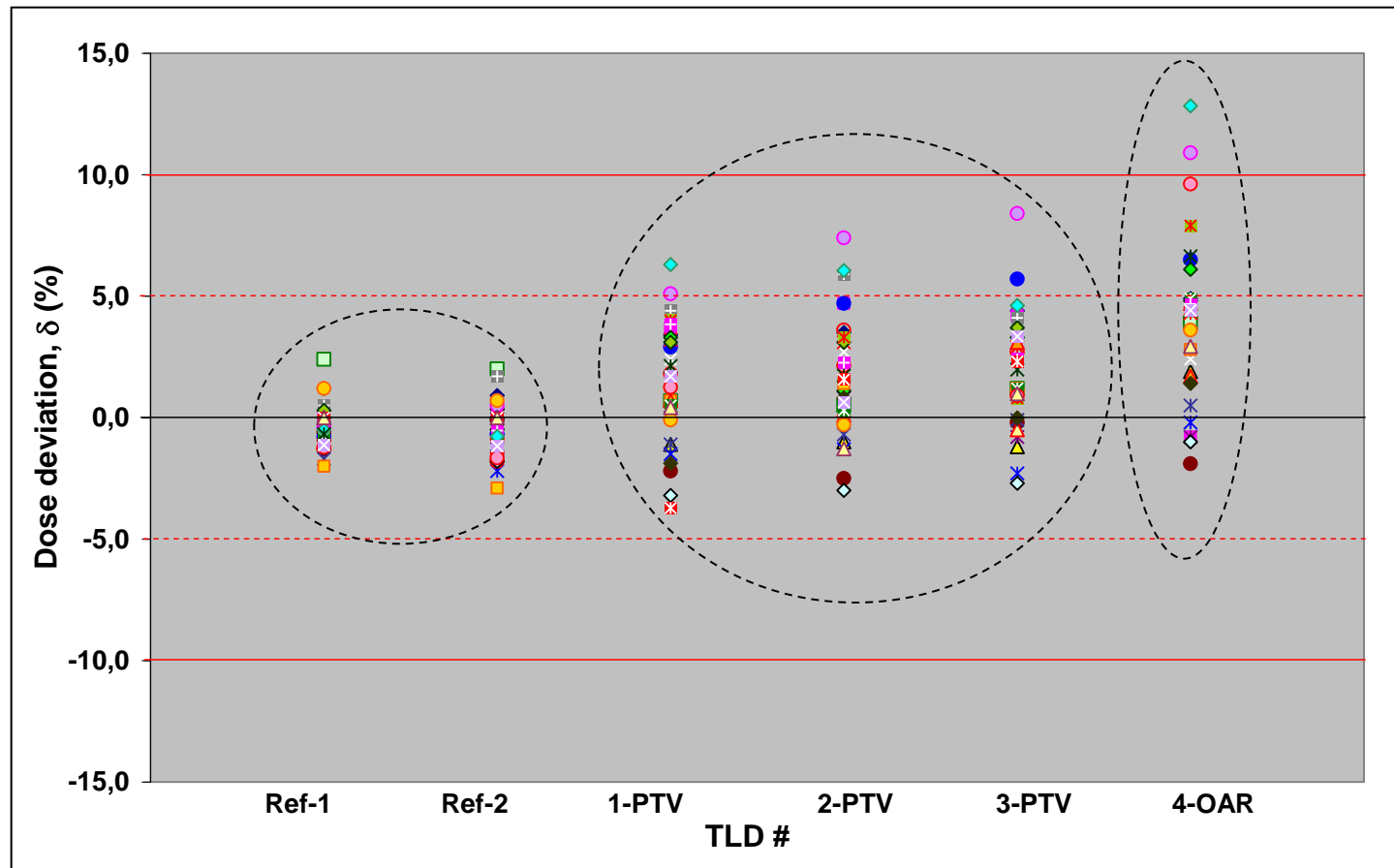
- For TLDs, dose deviation $\delta < 5\%$
- For films, dose deviation higher than 10% for less than 5% of pixels
- Minimal passing rate of Global Gamma Index, 5%-2mm, of 90%



Tests & Outcomes

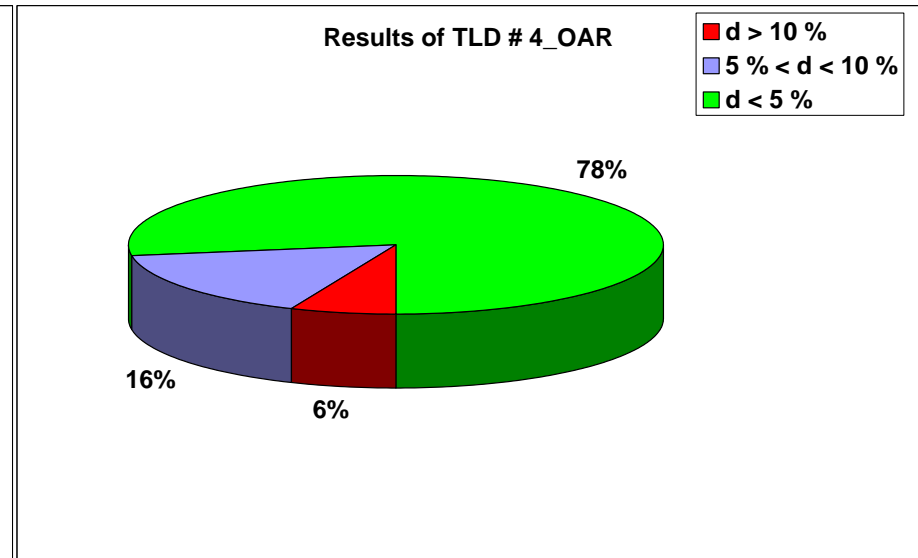
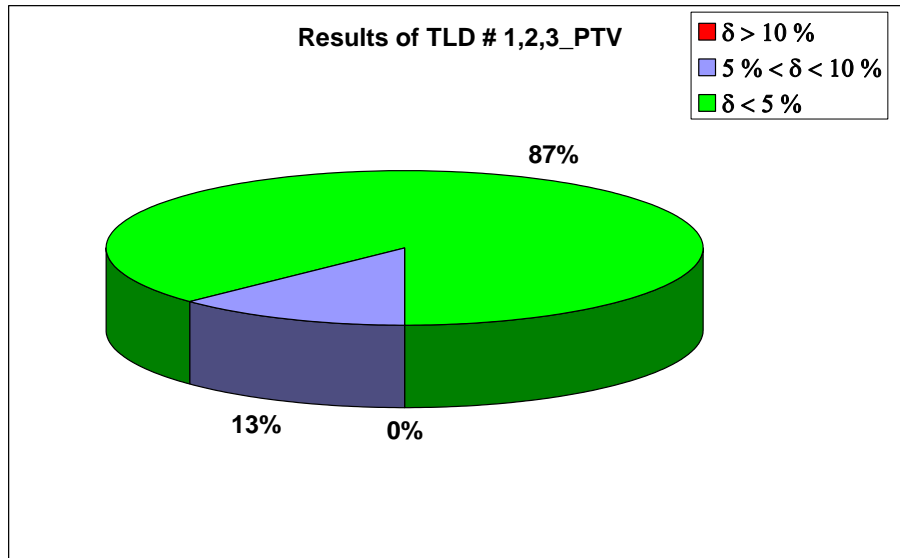
- **Most recent 32 tests**

- TLD measurements : 2 reference TLDs; 3 PTV TLDs & 1 OAR TLD



Tests & Outcomes

- **TLD test results**
 - PTV TLDs & OAR TLDs



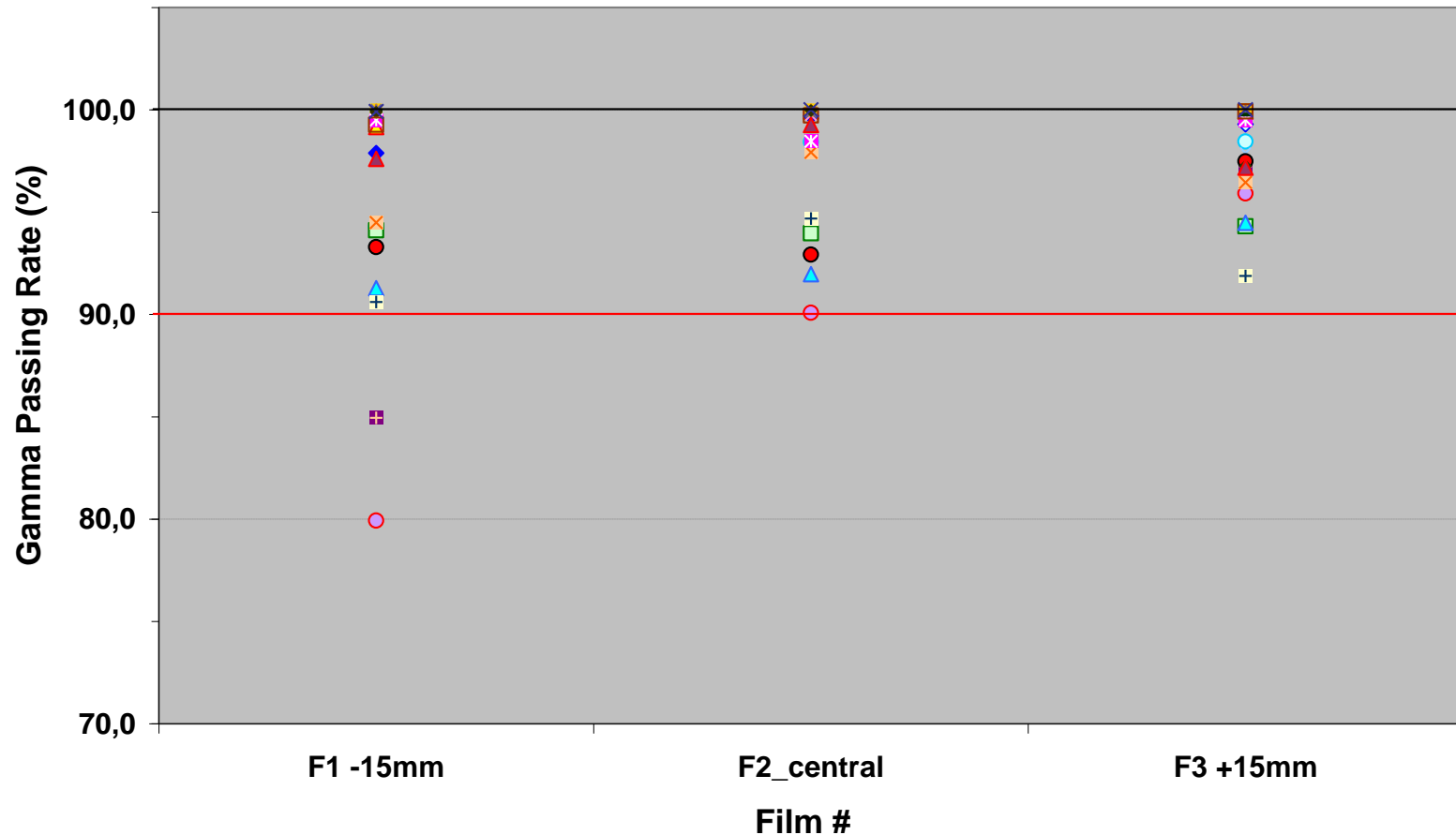
- **No dose deviations over the 10 % “emergency” limit**

- **About 22 % of “OAR” TLDs are above the 5% limit**

Tests & Outcomes

- **Film test results :**
 - Tests showing doubts of handling during shipment were not accounted for

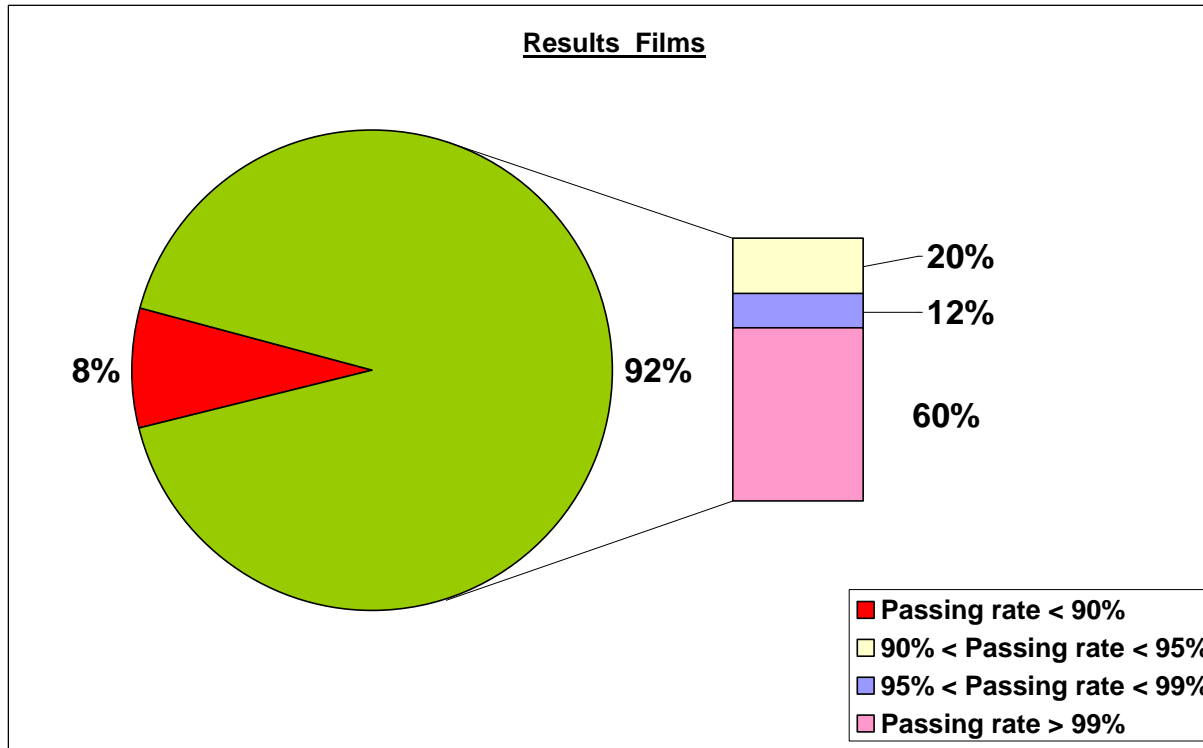
Film test results with 5%-2mm gamma criteria



Tests & Outcomes

- **Film test results**

- Only the lateral films, closest to the “OAR”-TLD, are accounted for in this statistics



- 92 % of tests show a passing rate above the 90 % limit
- 72 % of tests show a passing rate above 95 %
- 60 % of tests show a passing rate above 99 %

Discussion & Conclusion

- ❖ **Correlation between TLD results and film results ?**
 - ❖ Yes, otherwise there is a problem somewhere (shipment condition ?)
- ❖ **Why is the external QC useful ?**
 - ❖ The “users” should answer
- ❖ **How often ?**
 - ❖ At least after each major change on the “treatment chain”
- ❖ **By whom ?**
 - ❖ Independent, recognised and accredited entities

Acknowledgements:

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Thank You !