Nordic guidelines for dose reduction to radiosensitive organs of the patient in conventional radiography and fluoroscopy

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Statement from The Nordic Radiation Protection co-operation

Nordic Working Group on Medical Applications

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The Nordic Radiation Protection co-operation
for the radiation protection authorities in medical applications

- → 40 years celebration last year
- → Previous statements http//:nordicxray.gr.is
  - → Concerning the increase use of computed tomography in the Nordic countries
  - → Bismuth shielding of patients in CT examinations
  - → Position statement on justification of new types of practices involving medical exposure
  - → See also *Session S6-P1 History of NGMA*

  - → The current statement discuss the optimization in radiography for proper use of equipment and radiographic technique in medical applications

Why a statement for basic radiography?

→ Maybe education and training for radiographers for CT and MRI is favorized in relation to basic radiography?

→ Indication of high rates of re-takes in the collection of local DRL

Premises for this statement

→ A functional system for QA and QC

→ AEC is properly adjusted

→ Filtration is optimized for the actual procedure and laboratory

Projections – AP vrs. PA

→ HVL in human tissue = ~3 cm in conventional radiography (75 % of the dose in first 6 cm)

→ Normally ~1 % of the incident radiation reach detector

→ Organs more on the ventral (front) side: eye lens, breast tissue, intestines, uterus… will have a significant dose reduction in PA projections

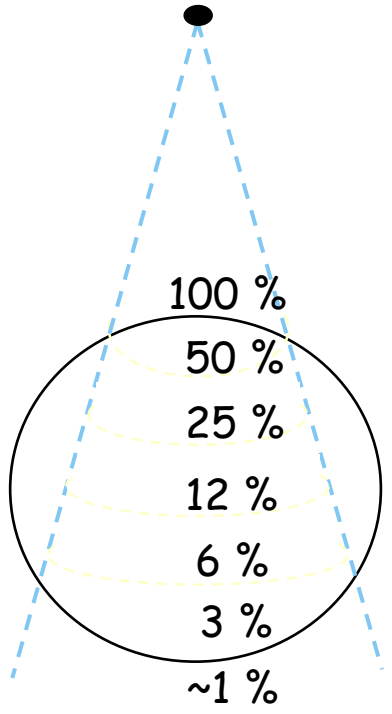
→ ICRP 2012 – Concern about radiosensitivity of the eye lens

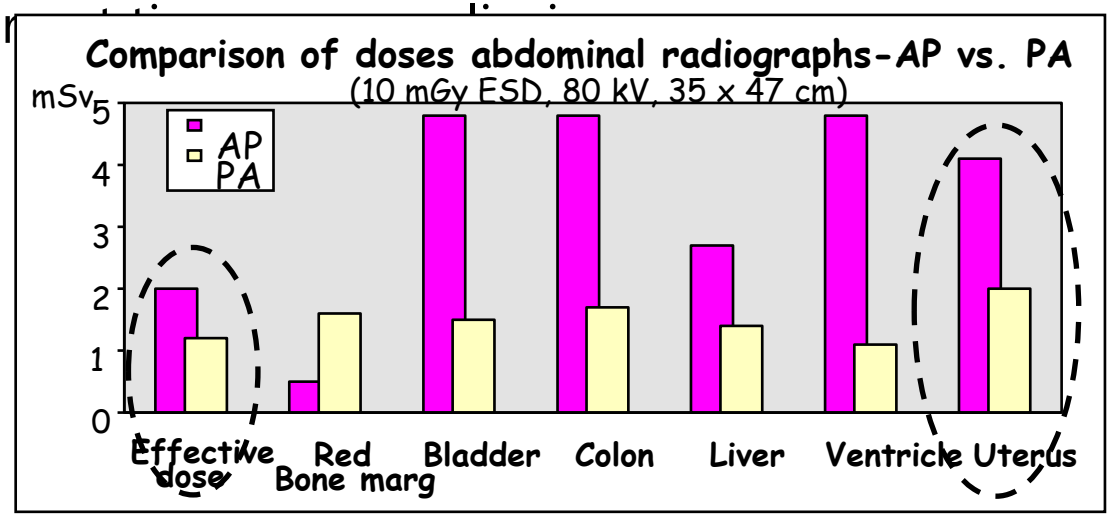
→ ICRP 2007 – W_T increased for breast tissue from 0.05 to 0.12

→ W_T factors are an average over the whole population (all ages and both sex)

→ Special precautions for young females and exposure of br… imaging

→ *PA projections - A significant decrease in radiation dose to many sensitive organs*





Collimation of radiation field to ROI

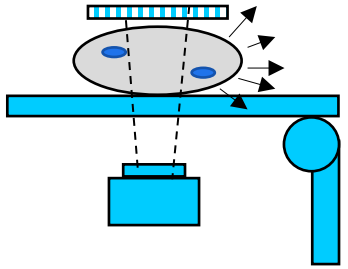
→ Avoid irradiating other organs unnecessary

→ Reduces the need for shielding of radiosensitive organs

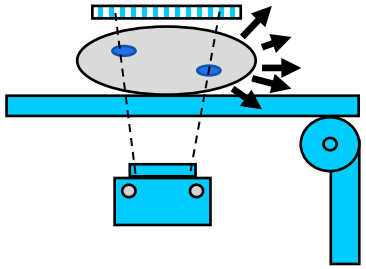
→ Reduces the amount of scattered radiation – Scatter increases linear with the irradiated area

→ Rectangular collimator in dentistry (requirement in Norwegian regulation from 2020)

→ *Strict collimation - Reduced scatter to other organs in patient, decreased staff exposure and increased image quality*



10x10 cm =100 cm^2



20x20 cm =400 cm^2

4 x more scatter

Use of grid

→ Increase the image quality, but also the dose ~x 3

→ Usually not necessary for children, due to smaller exposed volume

→ When planning for paediatric laboratory, look for equipment where the grid can be easily taken away, also for fluoroscopy

→ Consider if the grid is necessary when imaging children

Compression

→ More common in the past, but got a new renaissance due to more effective compression equipment

→ Most suitable for pelvis, lumbar spine and non-acute abdomen

→ HVL in tissue ~3 cm

→ Most patients can be compressed 7-8 cm in the abdominal area

→ Also, avoiding movement unsharpness

→ *Consider to implement the use of compression*

Gonad shielding – General comments

→ Very important in the 60's and 70's

→ Used mainly for reducing the risk for hereditary effects

→ ICRP 2007 reduced the risk estimates for hereditary effects by a factor of 6-8 times

→ Reflected in the decrease of W_T for gonads, from 0.20 to 0.08

→ One have to admit: Shielding of gonads was more important in the past!

→ UNSCEAR: «No radiation-induced hereditary diseases have so far been demonstrated in human populations. However, experimental studies in plants and animals have clearly demonstrated that radiation can induce genetic effects; consequently, humans are unlikely to be an exception in this regard.»

Gonad shielding - Males

→ Re-cycling of sperm have a cyclus of about 70 days

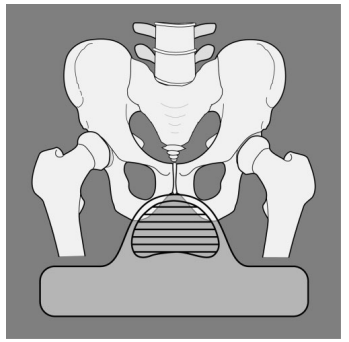
→ Shielding - Option when the radiation field is ≤5 cm from testes

→ Dedicated shielding equipment (capsules), age and size specific

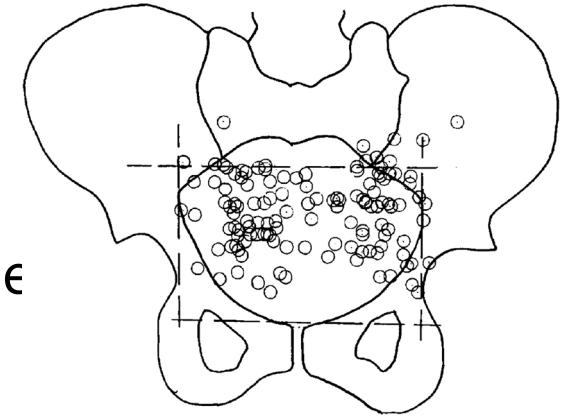
→ May reduce testes dose up to 95 %, if done properly

→ If it is a risk for re-takes or interfering with AEC - no shielding

→ *Use of gonad shielding on males are effective when used properly*



Gonad shielding - Females



→ The position of the ovaries can vary significantly, especially for younge females

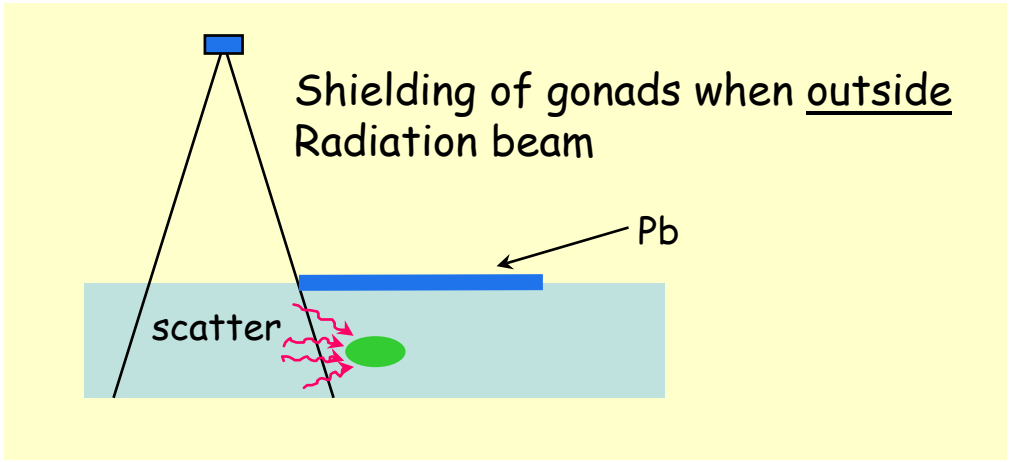
→ Contact shielding will not shield from scatter produced inside the body

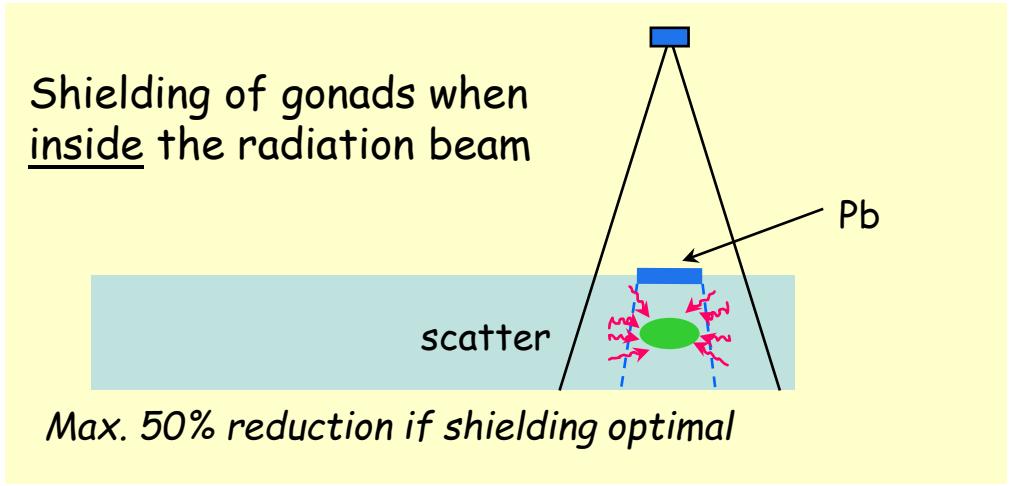
→ Max. 50 % reduction, but usually less…

→ Risk for re-takes

→ Interfering with the AEC

→ *Gonad shielding of females can be problematic. Using the other described methods will usually give a higher patient dose reduction*





Conclusion

→ Proper selection of equipment is essential

→ Good radiographic knowledge, technique and training are crucial for
the ALARA approach

→ Education and training is important in radiation protection

Thank you!