TEXAS
Health and Human Services

Texas Department of State Health Services

Safety Awareness

Occupational Radiation Exposure of the Eye Lens

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The Texas Department of State Health Services is partnering with the Texas Radiation Advisory Board (TRAB) to focus on radiation safety, by ensuring facilities are following best practices while performing fluoroscopically guided interventional (FGI) procedures. The National Council on Radiation Protection and Measurements (NCRP) is an advisory body with the mission of providing independent scientific analysis, information, and recommendations that represent the consensus of scientists on radiation protection in the United States. The U.S. Nuclear Regulatory Commission requested that the NCRP evaluate recommendations regarding eye lens doses in procedures that utilize fluoroscopy.

The International Commission on Radiological Protection (ICRP) reviewed epidemiological evidence and suggested that eye tissue reactions such as cataracts occur at radiation doses lower than those considered previously. This study has prompted a significant reduction in the annual occupational equivalent dose limit for the lens of the eye, endorsed by ICRP. The new ICRP recommendation for the occupational eye dose limit is an equivalent dose limit in the eye lens of 20 mSv/year, averaged over a defined 5-year period, with no single year exceeding 50 mSv. This is a significant reduction from the previous limit of 150 mSv/year [1]. The 25 Texas Administrative Code §289.231 has not changed regarding the annual limits to the lens of the eye, as this guide aims to enhance radiation safety by providing end-users with additional information that can be implemented into their current radiation safety program.

Low doses of radiation can cause permanent damage to the eye lens, leading to vision loss and cataracts. Higher doses can damage the iris, conjunctiva, sclera, and the retina's blood vessels. Regular exposure to x-rays increase the risk for not only early cataracts, but also retinal damage, tumor growth, glaucoma, and tear duct damage, which can result in dry eyes and make them more susceptible to infection [4].

Overall, radiation protection during fluoroscopic procedures should always include the principles of justification, dose optimization, and limitation with an emphasis on training, credentialing, planning, and quality management [3]. Once those principles have been applied during the pre-procedural phase, then the focus shifts to the implementation of safety factors to utilize during the procedure. Those safety factors are as follows:

- The ALARA 'as low as reasonably achievable' principle is the primary factor in reducing both occupational and patient radiation exposure during FGI procedures.
- Personnel shielding is of crucial importance for exposure reduction and can be attained at different levels. The most important shielding factors for personnel safety is a lead apron, a thyroid collar, and lead glasses. Leaded glasses attenuate radiation that passes through the lenses, preventing much of the harmful rays from reaching your eyes and reducing the effects of X-rays by blocking or bouncing particles. One should be aware that this protection equipment undergoes wear and tear and requires periodic inspections to ensure that the shielding remains safe for personnel protection. Equipment and ceiling-mounted shielding, generally constructed of transparent leaded plastic, and protective lead drapes should always be employed, as these have proven to substantially reduce occupational radiation dose; especially the dose obtained by the eye lens [1].
- A personal dosimeter worn on the outside of a lead apron or thyroid collar provides a reasonable estimate of the dose delivered to the surface of the unshielded skin and the lens of the eye [2].

Research and technology are constantly evolving, and the overall intent of this practice guide is to assist physicians, qualified medical physicists, radiologic technologists, and other ancillary personnel in attaining and maintaining eye lens protection during FGI procedures.

References

1. Dauer, L. T., Hamada, N., & Blakely, E. A. (2017). National Council on Radiation Protection and Measurements Commentary Number 26: Impact of Revised Guidance on Radiation Protection for the Lens of the Eye. Journal of the American College of Radiology: JACR, 14(7), 980–982. doi: 10.1016/j.jacr.2017.05.003
2. International Commission on Radiological Protection. ICRP Statement on Tissue Reactions/Early and Late Effects of Radiation in Normal Tissues and Organs – Threshold Doses for Tissue Reactions in a Radiation Protection Context, ICRP Publication 118. Ann. ICRP. 2012;41(1–2)
3. U.S. Food and Drug Administration. (2019) Initiative to Reduce Unnecessary Radiation Exposure from Medical Imaging. Retrieved from: https://www.fda.gov/radiation-emitting-products/radiation-safety/initiative-reduce-unnecessary-radiation-exposure-medical-imaging
4. American Journal of Roentgenology. (2016) Radiation Risk to the Fluoroscopy Operator and Staff. Retrieved from: https://www.ajronline.org/doi/full/10.2214/AJR.16.16555