A SYSTEMATIC APPROACH TO DOSE OPTIMIZATION IN PEDIATRIC DIGITAL IMAGING

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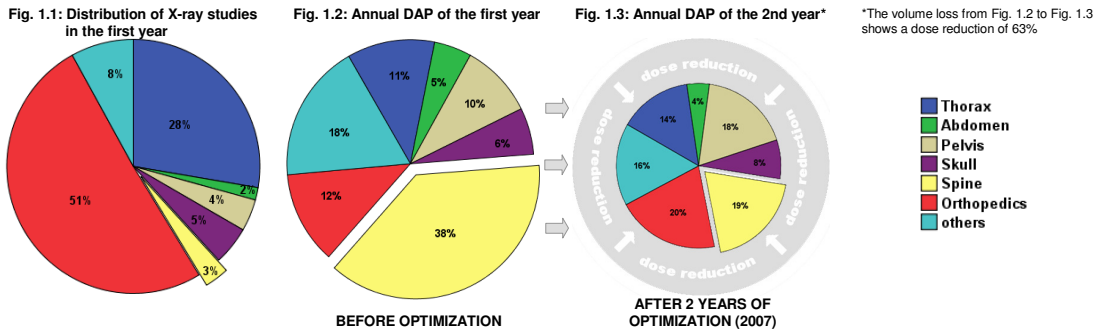
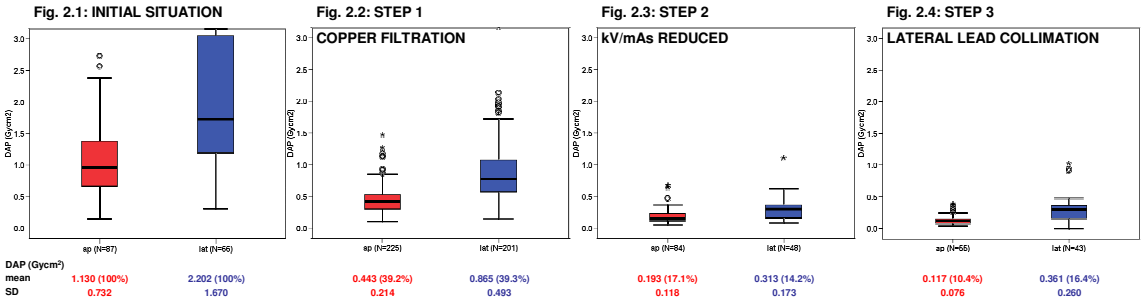
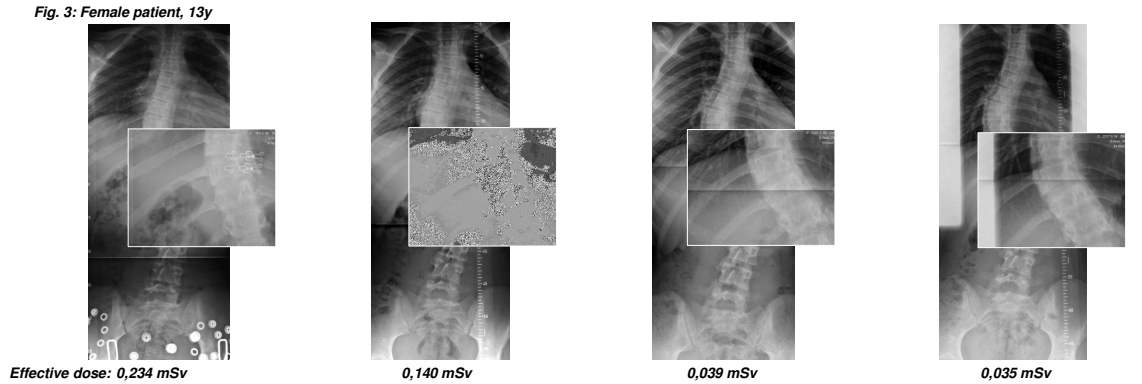
Purpose: To minimize the individual dose of each patient by means of a comprehensive quality assurance project. This was achieved by a controlled stepwise reduction of the pediatric exposure dose to the medical minimum as exemplified by a systematic dose reduction in full spine digital imaging.

Method: In October 2005, a unique comprehensive quality assurance project in pediatric radiology (DoseWatchers) was initialized at the University Hospital Inselspital Bern. The core of the DoseWatchers project is a server/client-based system (EasyDose), which collects and manages the exposure parameters. After a two-year period of X-ray data collection, the data gathered during the major part of the X-ray studies have been analyzed as a baseline for further optimization of low dose diagnostics. Dose and image quality of the full spine studies were analyzed and stratified into four subgroups according to the initial situation and the three reduction steps (Fig. 2.1-2.4). Within these four groups the dose reduction potential was determined whilst simultaneously maintaining diagnostic image quality.







Results: Up to date the database contains 62976 entries of 31490 studies. The system works at a high automation level and generates a comprehensive database over several years for further analyses. Even though whole spine X-ray images represented only 3% of all expositions (Fig. 1.1) they accounted for 38% of the overall annual X-ray dose (Fig. 1.2). Full spine: The dose-area product (DAP) of lateral expositions is about twice as high as those of antero-posterior (ap) views. With each step a highly remarkable reduction in DAP in ap as well as in lateral expositions was achieved, except for step 3 in lateral exposition. In full spine imaging the applied entrance radiation dose can be reduced up to 10% in ap views and to 16% in lateral views, respectively, without subjective loss of the diagnostic image quality. The effective dose was reduced by 81 %.

Conclusion: The EasyDose system proves to be an ideal instrument to monitor exposition modifications systematically. Spinal X-ray studies are at the upper end of the pediatric dose level scale in plain X-ray imaging. The radiation dose can be lowered substantially by a systematic optimization approach without losing diagnostic image quality. These applications can be performed in any X-ray projection with similar results.