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Evaluation of the occupational radiation exposure from C-arm fluoroscopy during common orthopaedic surgical procedures: DAP based dose simulation method

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Background: Modern fluoroscopic C-arms have revolutionized the application of fluoroscopic C-arms in a wide range of orthopaedic surgeries. C-arm fluoroscopy may increase the risk of radiation-induced carcinoma among staff engaged in orthopaedic surgeries due to long term exposure.

Objective: Aim was to determine the occupational radiation doses to the orthopaedic theatre staff during C-arm fluoroscopy-guided common orthopaedic theatre procedures, and to compare them with standard international reference values.

Methods & Materials: The theatre records for three months were assessed in two selected hospitals in Sri Lanka, and three of the most common orthopaedic surgeries for both hospitals were selected (dynamic hip screw, tibial plateau fracture, and distal radial fracture). Fifty surgeries from each hospital were observed and the end Dose Area Product (DAP) values were recorded prospectively. Four occupations were selected namely, orthopaedic surgeons, anaesthetists, radiographers, and nurses (n=400). The dose values were simulated using DAP based occupational dose estimation method. All simulated dose values per surgery, extrapolated as annual doses were tested with one-sample t-test to compare with the international recommended level (<20.0mSv per year). ANOVA was performed to compare the mean dose values acquired by each theatre personnel during the same surgery. $P<0.05$ was considered significant.

Results: The estimated mean annual dose was 0.977 mSv per year. All doses were well within the reference level i.e. less than 20mSv per year ($t=-46.58$, $p=0.000$). According to the ANOVA, the mean doses acquired by each theatre personnel during the same surgery were different from each other ($p<0.001$). In most instances, the highest occupational dose was acquired by the orthopaedic surgeon (88.89%) while the lowest was acquired by the anaesthetist (77.78%).

Conclusion: During orthopaedic surgeries in selected hospitals, all the theatre staff were exposed to radiation doses well within the permissible limit.