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Radiation Exposure to the Eye with Mini C-arm Use During Hand Surgery

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INTRODUCTION

Fluoroscopic radiation exposure is a potential occupational health risk to the Hand Surgeon, given operator proximity and the relative lack of eye shielding. The association of eye radiation exposure and the early development of cataracts has been previously reported. Mini C-arm fluoroscopy is commonly utilized during routine Hand Surgery. At present, the amount of radiation exposure to the eye, associated with the routine use of mini C-arm fluoroscopy, is unknown, thus warranting further investigation. The purpose of this study is to test the hypothesis that eye radiation exposure, sustained during routine mini C-arm use, does not exceed that of previously reported critical radiation dosages to the eye.

MATERIALS AND METHODS

Over a four month period, eye radiation exposure was measured in four board-certified Hand Surgeons utilizing mini C-arm fluoroscopy (OrthoScan, Scottsdale, AZ) during routine surgical procedures. Eye dosimeters were secured to surgical loupes at the level of the orbit. Accumulated radiation dosage was analyzed and compared to control badges on a monthly basis, and background exposure was eliminated (Landauer, Glenwood, Illinois). For each procedure, mini C-arm radiation output was logged, including the dose rate, total accumulated dosage, and total exposure time.

RESULTS

Average monthly eye dosimetry values included the following: dose rate was 0.50±0.03 mGy/sec, total accumulated dosage was 32.16±7.88 mGy, and total exposure time was 75.72±16.36 sec. Average monthly eye radiation exposure values were less than 30 mrem (previously reported maximum eye dosage is 1,250 mrem per month). A total of 46 procedures were performed over the collection period. The most commonly performed procedures included ORIF distal radius fractures (14), metacarpal and phalangeal surgery (9), and basilar thumb arthritis surgery (7). ORIF of the distal radius fracture was associated with higher average exposure time (93.57 sec) and average accumulated dosage (51.73 mGy).

TABLE 1

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of procedures</th>
<th>Average Number of Angioscopic Films</th>
<th>Average Time (sec)</th>
<th>Accumulated Dosage (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORIF Distal Radius Fractures</td>
<td>14</td>
<td>25.8</td>
<td>93.57</td>
<td>51.73</td>
</tr>
<tr>
<td>Metacarpal Phalangeal Arthritis</td>
<td>9</td>
<td>24.3</td>
<td>75.72</td>
<td>32.16</td>
</tr>
<tr>
<td>Metacarpal Phalangeal Arthritis</td>
<td>9</td>
<td>24.3</td>
<td>75.72</td>
<td>32.16</td>
</tr>
<tr>
<td>Orthopedic Foot Arthritis</td>
<td>7</td>
<td>24.3</td>
<td>75.72</td>
<td>32.16</td>
</tr>
<tr>
<td>ORIF Olif Fracture</td>
<td>7</td>
<td>24.3</td>
<td>75.72</td>
<td>32.16</td>
</tr>
<tr>
<td>ORIF Distal Radius Fractures</td>
<td>14</td>
<td>25.8</td>
<td>93.57</td>
<td>51.73</td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

Cataract is the most prevalent eye disease in the world and is ranked as one of the top eye diseases by the World Health Organization (WHO). The current concept, on the pathogenesis of radiation-induced cataract formation, suggests that oxidative stress, generated by radiation exposure, results in the accumulation of reactive oxygen species, contributing to DNA damage to the lens epithelium. This cumulative DNA damage to the eye can result in the cataractous lens.

REFERENCES

