Intraoperative radiation exposure in hip arthroscopy: a systematic review

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Hip arthroscopy is a minimally invasive procedure aimed at managing intra- and extra-articular pathologies\(^1\).

Its popularity is rapidly increasing, with an 18-fold increase in the number of procedures performed from 1999 to 2009\(^2\).

Diagnostic imaging is a key component of the diagnosis and treatment of hip pathologies\(^3,4\).

- Preoperative X-rays and CT scans, Intraoperative fluoroscopy, Postoperative imaging are all commonly used.
Intra-operative fluoroscopy is used to assist with:
- Portal placement
- FAI evaluation and correction
- Avoiding chondrolabral injury

However, the use of ionizing radiation may exert harmful effects on patients and healthcare workers.
Background

- Grays (Gy) – for radiation absorbed dose
- Sieverts (Sv) – for intensity of ionization\(^6\)

- Deterministic effects – acute radiation injury from high dose exposures (eg: skin burns)
- Stochastic effects – long-term effects of low dose exposures (eg: carcinogenesis)\(^7,8\)
The purpose of this systematic review is to provide a summary of the literature analyzing intraoperative radiation exposure to patients and operating staff in HA.
Methods

- The search terms “arthroscopy”, “hip”, “fluoroscopy”, and “radiation” were used to search MEDLINE, PubMed, and Embase from database inception to April 18th, 2018.
- Titles, abstracts, and full-text articles were screened in duplicate.
- Inclusion criteria were therapeutic studies written in English, human studies, living subjects, and studies on intraoperative radiation exposure in hip arthroscopy.
- Exclusion criteria were animal studies, book chapters, non-English studies, review articles, and technical reports.
- The results were presented in narrative summary fashion.
- The Methodological Index for Non-Randomized Studies (MINORS) was used to assess the quality of the included studies.
Results

Study Characteristics

- 9 studies included
  - 8 retrospective cohort studies
  - 1 randomized controlled trial (RCT)

- The mean MINORS score was 13.5 (out of 16)

- 697 total procedures
- Mean fluoroscopy time was 0.58 min (range, 0.01-2.10 min)
Results

Deterministic Effects (8 studies)
- Mean Dose Area Product (DAP) was 129.5 cGycm² (n=207, 0.201-897 cGycm²)
- Mean intraoperative absorbed radiation dose was 12.6 mGy (n=318, 3.0-52 mGy)

Stochastic Effects (6 studies)
- Mean intraoperative effective dose was 0.48 mSv
  - Perioperative effective dose from:
    - Preoperative CT (2.35 mSv)
    - Plain films (3.50 mSv)
- The risk of developing a hereditary disorder was 0.0602-0.1005 per $10^6$ patients
Occupational Effects

- Exposure per case:
  - Surgeon: 0.0031 mSv
  - Resident, Circulating Nurse: 0.0012 mSv
  - Scrub Technician: 0.0096 mSv

- Increasing surgeon experience decreased fluoroscopy time and radiation dose
- Higher patient BMI increased occupational exposure
Overall, intraoperative radiation exposure was low:

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Comparison</th>
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<tr>
<td>12.6 mGy (exposure to patients)</td>
<td>2 Gy dose causes local skin erythema</td>
</tr>
<tr>
<td>0.48 mSv (exposure to patients)</td>
<td>1.4-3 mSv of annual background radiation</td>
</tr>
<tr>
<td>0.62 mSv (annual exposure to surgeons)</td>
<td>20 mSv limits for radiation workers (ICRP)</td>
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Studies advocated for:
- Use of leaded eyeglasses and real-time dosimetry\textsuperscript{9,10}
- Education on radiation beginning in residency\textsuperscript{11}
- Adequate C-arm positioning\textsuperscript{12,13}
- Ensuring complete bony resection is of the utmost importance
Conclusions

- Intraoperative radiation exposure to patients and surgeons is within acceptable annual radiation limits
- Ensuring proper positioning and protective shielding are key strategies to reduce radiation exposure to patients and surgeons


