Intraoperative Low-Dose Computed Tomography (CT) Scan in Pediatric Hip Reductions for Developmental Dysplasia of the Hip: Improved Workflow and Accurate Results from a Low-Dose Institutional Radiation Protocol

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INTRODUCTION: Pediatric patients with developmental dysplasia of the hip (DDH) who fail nonsurgical management (Pavlik harness or abduction bracing) are indicated for surgical management of the hip under general anesthesia. Traditionally, following hip reduction and spica cast application, a post-reduction magnetic resonance imaging (MRI) is performed to confirm concentric reduction and evaluate the need for revision surgery. This workflow necessitates that the patient leaves the operating room (OR) for the MRI suite. In some institutions, the patient remains intubated, prolonging the anesthetic event time and increasing patient risk, especially in this young patient population. Additionally, any potential complications necessitating revision surgery may lead to delays in care as the patient may have to return to the OR on the same or a later day. To address these limitations, our institution has implemented the use of a low-dose intraoperative CT-scan in the OR at the time of the index procedure aimed at confirming appropriate concentric hip reduction immediately post-casting without the need for prolonged anesthetic time or subsequent anesthetic events, while simplifying the OR team's workflow as any changes can be made at that time. This study's objective was to evaluate radiation exposure following the implementation of our updated low-dose CT protocol.

METHODS: A retrospective review of medical records was performed, identifying patients who underwent open or closed hip reductions and spica casting for DDH at our institution from 2020-2025. All patients had a post-spica cast intraoperative CT scan utilizing the O-arm (O-arm™ Surgical Imaging system) at the conclusion of the index procedure. Group 1 consisted of DDH patients that underwent a single O-arm spin of the traditional low dose protocol of 80 KV:80 mAs. Group 2 consisted of patients with the updated lower radiation protocol of patients 70 KV:60 mAs. Patient demographics, surgical variables, radiation exposure (effective dose in millisieverts [mSv]), and the need for revision reductions or additional imaging were collected. Radiation doses were compared against reference values for standard pelvic radiographs.

RESULTS: We identified six patients in group 1 and eight patients in group 2. Patients in group 1 had a mean age of 1.39 years (SD = 0.86), while those in group 2 had a mean age of 2.07 years (SD = 0.92). All patients underwent a single O-Arm spin at the end of the procedure. The mean effective radiation dose for a single O-arm spin for group 1 was 1.58 ± 0.18 mSv and for the updated lower radiation protocol was 0.65 ± 0.08 mSv ($p < 0.001$), comparable to one pelvic radiograph (0.6 mSv). All hips were concentrically reduced, and no cases required revision imaging. No patients underwent a second spin at the index procedure.

DISCUSSION AND CONCLUSION: Low-dose intraoperative CT following surgical treatment of DDH in pediatric patients provides immediate confirmation of concentric hip reduction, with a total radiation exposure comparable to a standard single pelvic radiograph. The low-dose (70 KV:60 mAs) imaging protocol eliminates the need for MRI or additional anesthetic events, improves workflow for the OR staff, and streamlines patient care.