

# The most typical mistakes made during pelvic X-ray in pediatric patients

Mahmud Aydın<sup>1</sup>, Serkan Sürücü<sup>2</sup>, Onur Özel<sup>1</sup>, Onur Demirsu<sup>1</sup>, Murat Yılmaz<sup>1</sup>

<sup>1</sup>Haseki Education Research Hospital, Department of Orthopaedics and Traumatology, İstanbul, Turkey

<sup>2</sup>University of Missouri Kansas City, Department of Orthopaedic Surgery, Kansas City, United States

**Cite this article as:** Aydın M, Sürücü S, Özel O, Demirsu O, Yılmaz M. The most typical mistakes made during pelvic X-ray in pediatric patients typical mistakes made during pelvic X-ray. J Health Sci Med 2022; 5(3): 805-808.

## ABSTRACT

**Aim:** This study aimed to identify the most common mistakes made during pelvic radiography in pediatric patients and to give advice to physicians and technicians on how to avoid these mistakes.

**Material and Method:** Between 2016 and 2020, 1150 pelvic radiographs (in pediatric patients for any reason) were analyzed by two independent orthopaedic surgeons. Radiographs taken in trauma patients were not included in the study due to the patient's discomfort and agitation. Interobserver and intraobserver reliability for radiographic measurements were determined using intra-class correlation coefficients (ICC) obtained from three replicate sets of measurements on a sample of 1150 radiographs recorded by each observer at least one week apart.

**Results:** The mean age of the patients included in this study was 4.28±3.86 (range: 0-14) years. Of the 1150 patients, 935 (81.30%) were female and 215 (18.69%) were male. When pediatric pelvic radiographs were evaluated, the most common mistake was made during gonad protection. It was found that 71.22% of the patients' gonads could not be protected. While this rate was 82.24% in female patients, this rate was 23.34% in male patients. There was a statistically significant difference when compared by gender ( $p=0.015$ ). Giving the malposition was the second most common mistake.

**Conclusion:** The most common errors in pediatric pelvic radiographs are failure to provide gonad protection and malposition of the patient. To minimize these errors, it is necessary to inform both the doctor and the technician.

**Keywords:** Gonad protection, malposition, pediatric patients, pelvic radiography

## INTRODUCTION

Children are more susceptible to radiation exposure than adults due to an abundance of rapidly proliferating cells in the bodies (1-3). Additionally, pediatric patients' longer life expectancy significantly increases their risk of developing cytochemia as a result of radiation dosages when compared to adult patients (3). Due to the significant differences between pediatric imaging algorithms and those used in the adult population, it has been established that treating radiography errors differently in children versus adults is critical (4,5).

Menashe et al. focused their research on radiographic errors in pediatric chest and abdomen radiography. They raised awareness regarding radiographic errors through the cases presented in their study (5,6). Another critical issue with pediatric patients is the preservation of the gonads on pelvic radiographs (7-9).

We were unable to locate any study investigating the frequency of radiographic errors made during pelvic radiography in pediatric patients when we searched the literature. The purpose of this study was to determine the most frequently committed errors during pelvic radiography in pediatric patients and to advise physicians and technicians on how to avoid them.

## MATERIAL AND METHOD

The study was approved by the SBÜ Haseki Training and Research Hospital Ethics Committee (Date: 24.11.2021, Decision No: KAEK- 2021-232). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Between 2016 and 2020, 1150 pelvic radiographs (in pediatric patients for any reason) were analyzed by two

independent orthopedic surgeons using data received from the institution's database. Due to the patient's pain and agitation, radiographs obtained in trauma patients were excluded from the study. Independent analysis of the compared images was performed to ascertain the data's consistency. Interobserver and intraobserver reliability for radiographic measurements were determined using intra-class correlation coefficients (ICC) obtained from three replicate sets of measurements on a subset of 1150 radiographs taken at least one week apart by each observer. The following scores were used: ICC >0.80 indicates excellent; 0.70-0.80 indicates very good; 0.60-0.70 indicates good; 0.40-0.60 indicates fair; and 0.40 indicates poor.

The top five mistakes made during pelvic X-rays in pediatric patients were identified.

1. Positioning
2. Gonad protection
3. Radiation dose
4. Labels or markers
5. Movement

**Positioning:** X-ray of the pelvis, both hips visible, the obturator foramen should be in its optimal symmetrical position (10).

**Radiation dose:** The optimal radiation dose should be between 3.06 and 4.57  $\mu$ Sv (11).

**Gonad protection:** Shields should be placed around the testicles of males and the ovaries of females to protect them (12).

**Labels or markers:** While marking the radiographic, it was found essential to enter the patient's name, age, and the radiographic's direction.

**Movement:** The patient should not move during the X-ray.

For descriptive statistics, categorical variables were presented as numbers and percentages, and continuous variables were presented as mean, standard deviation, minimum and maximum values.

## RESULT

The mean age of the patients included in this study was  $4.28 \pm 3.86$  years (range, 0-14 years). 935 (81.30%) of the 1150 patients were female, while 215 (18.69%) were male.

When pediatric pelvic radiographs were evaluated, the most common mistake was made during gonad protection. It was shown that 71.22% of patients' gonads were unable to be protected (**Figure 1**) (**Table 1**). While this rate was 82.24% for female patients, it was just 23.34% for male patients. When gender was compared, there was a statistically significant difference ( $p= 0.015$ ) (**Table 2**). Giving the incorrect position was the second most frequent

mistake (**Figure 2**). It was discovered that 27.34% of patients were unable to be properly positioned. In 5.65% of patients, a movement was identified during radiography. Radiation doses were within the acceptable level in all cases. 2.42% of patients had radiographs with incorrect labels or markers. There was no statistically significant correlation between the patients' ages and the mistakes made ( $p < 0.001$ )



**Figure 1.** X-ray of the pelvis with incorrect application of the gonad protector



**Figure 2.** X-ray of the pelvis of a patient who has been given a malposition

When we analyzed intraobserver and interobserver correlations, we discovered that angle measurements had an almost perfect interobserver agreement (ICC, 0.97; confidence interval [CI], 0.96-0.99) and intraobserver agreement (ICC, 0.97; CI, 0.96-0.99) (ICC, 0.94; CI, 0.89-0.96).

**Table 1.** Percentage of mistakes

Mistakes	percent
Gonad protection	71.22%
Positioning	27.34%
Movement	5.65%
Labels or markers	2.42%
Radiation dose	0.0%

**Table 2.** Comparison of gonad protection mistakes by gender

Gender	Number	Percent	p-value
Female	935	81.30%	0.015
Male	215	18.69%	

## DISCUSSION

The study revealed that the most frequently made error in pediatric patients was a failure to protect the gonads. We discovered that this error was made in 71.22% of cases. In comparison to other types of mistakes, this rate was relatively high. When we compared the findings to the existing literature, they were found to be consistent.

According to Liokas et al. (8), present shielding procedures did not adequately protect the ovaries from radiation exposure during pelvic radiography. They concluded that we did not preserve the gonads on prepubertal female pelvic X-rays. Kaplan et al. (13) stated in their study that the gonads could not be adequately protected in females and that the radiation dose absorbed by the gonads increased as a result of the protectors' incorrect positioning. They advised against its use. Kumar et al. (14) likened the gonadal shield to an Albatross hanging around the neck of developmental hip dysplasia. They reported that when gonad protectors are utilized, they degrade the image and may result in data loss. We believe that gonad protectors are unnecessary, as girls' gonads cannot be preserved. However, we advocate that male patients receive gonadal protection because it is simple and effective.

Malpositioning was the second most frequently occurring error in pediatric patients, occurring at a rate of 27.34%. Malpositioning might result in incorrect radiographic interpretation and misdiagnosis. According to Li et al. (15), malpositioning impairs the assessment of the lateral and anterior central margin angles. This study highlights the crucial importance of validating the radiographic quality to guide hip pathology treatment. Brockmeyer et al. (16) examined the use of basic devices to assure proper placement. The study's findings, however, indicated that simple positioning devices do not yield standardized anteroposterior pelvic radiographs. We recommend that technicians be taught how to properly position the graph to avoid positioning issues.

Another error that occurs during pediatric pelvic X-rays is the mismarking of the X-ray. The most critical

information to note on the X-ray is the patient's name and age for accurate diagnosis and treatment. When we analyzed the radiographs, it was revealed that the most significant error made when marking was the lack of the direction sign. Given the critical nature of determining the correct orientation during surgical procedures, it is critical to eliminate this error.

Hip developmental dysplasia is the most prevalent reason for pelvic X-rays in children. From this vantage point, the fact that the same patient is repeatedly exposed to radiation during the controls is worrisome. Vogel et al. (16) assessed the radiation risk associated with children's X-ray exposure and identified the lifetime risk of malignancy in individuals undergoing roentgenography for hip developmental dysplasia as very low risk. Additionally, they stated that this information might be utilized to reassure parents who are concerned.

The limitations of this study were single-centered and the requirement of radiography was not evaluated.

## CONCLUSION

The most frequently made errors in pediatric pelvic radiographs are failing to protect the gonads and patient malposition. To minimize these mistakes, the doctor should first be informed in detail about the issue, followed by the technician, who should be informed based on the frequency of the errors.

## ETHICAL DECLARATIONS

**Ethics Committee Approval:** The study was approved by the SBÜ Haseki Training and Research Hospital Ethics Committee (Date: 24.11.2021, Decision No: KAEK-2021-232).

**Informed Consent:** Because the study was designed retrospectively, no written informed consent form was obtained from patients.

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

**Author Contributions:** All of the authors declare that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version.

## REFERENCES

1. Kutanzi KR, Lumen A, Koturbash I, Miousse IR. Pediatric Exposures to Ionizing Radiation: Carcinogenic Considerations. *Int J Environ Res Public Health* 2016; 13: 1057.
2. Kleinerman RA. Cancer risks following diagnostic and therapeutic radiation exposure in children. *Pediatr Radiol* 2006; 36: 121-5.

3. Khong PL, Ringertz, H, Donoghue V, et al. Radiological protection in pediatric diagnostic and interventional radiology. *Ann. ICRP* 2013; 42: 1-63.
4. Bisset GS, Crowe J. Diagnostic errors in interpretation of pediatric musculoskeletal radiographs at common injury sites. *Pediatr Radiol* 2014; 44: 552-7
5. Menashe SJ, Iyer RS, Parisi MT, Otto RK, Weinberger E, Stanescu AL. Pediatric abdominal radiographs: common and less common errors. *AJR Am J Roentgenol* 2017; 209: 417-29.
6. Menashe SJ, Iyer RS, Parisi MT, Otto RK, Stanescu AL. Pediatric chest radiographs: common and less common errors. *AJR Am J Roentgenol* 2016; 207: 903-11.
7. Wainwright AM. Shielding reproductive organs of orthopaedic patients during pelvic radiography. *Ann R Coll Surg Engl* 2000; 82: 318-21.
8. Liakos P, Schoenecker PL, Lyons D, Gordon JE. Evaluation of the efficacy of pelvic shielding in preadolescent girls. *J Pediatr Orthop* 2001; 21: 433-5.
9. Gürsu S, Gürsu T, Çamurcu Y, Yıldırım T, Gürsu A, Şahin V. Efficacy of gonadal shielding in pediatric pelvis X-rays. *Eklemler Hastalıkları* 2013; 24: 87-90.
10. Alzyoud K, Hogg P, Snaith B, Flintham K, England A. Optimum positioning for anteroposterior pelvis radiography: a literature review. *J Med Imaging Radiat Sci* 2018; 49: 316-24.
11. Kloth JK, Neumann R, von Stillfried E, et al. Quality-controlled dose-reduction of pelvic X-ray examinations in infants with hip dysplasia. *Eur J Radiol* 2016; 85: 233-8.
12. Fawcett SL, Barter SJ. The use of gonad shielding in pediatric hip and pelvis radiographs. *Br J Radiol* 2009; 82: 363-70.
13. Kaplan SL, Magill D, Felice MA, Xiao R, Ali S, Zhu X. Female gonadal shielding with automatic exposure control increases radiation risks. *Pediatr Radiol* 2018; 48: 227-34.
14. Kumar A, Chau WW, Hung AL, Wong JK, Ng BKW, Cheng JCY. Gonadal shield: is it the Albatross hanging around the neck of developmental dysplasia of the hip research? *J Child Orthop* 2018; 12: 606-13.
15. Li RT, Hu E, Gould H, Valentin N, Salata MJ, Liu RW. Does pelvic rotation alter radiologic measurement of anterior and lateral acetabular coverage? *Arthroscopy* 2019; 35: 1111-6.
16. Brockmeyer M, Lott S, Stroeder J, et al. Simple mechanical devices did not improve pelvis positioning in AP pelvis radiographs for reliable assessment of the acetabular orientation. *J Exp Orthop* 2019; 6: 20.
17. Vogel E, Leaver T, Wall F, Johnson B, Uglow M, Aarvold A. Repeated pelvic radiographs in infants, after harness treatment for developmental dysplasia of the hip, carry very low radiation risk. *Indian J Orthop* 2021; 55: 1543-8.