International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2025: 7.089

Mid-Shaft Femur Fracture in a 22-Year-Old Woman at 20 Weeks of Gestation: A Case Report on Multi-Disciplinary Management

Minish Katkar[1], Shraddha Walse[2], Samiksha Dhama[3]

[1]Assistant Professor, Department of Orthopedics, Government Medical College, Alibag, Mumbai, Maharashtra, India

[2]Junior Resident, Department of Obstetrics & Gynaecology, D.Y. Patil School of Medicine, Navi Mumbai
Corresponding Author Email: *shraddhawalse.15[at]gmail.com*

[3]Senior Resident, Department of Obstetrics & Gynaecology, Government Medical College, Alibag, Mumbai, Maharashtra, India

Abstract: ***Background: Femoral shaft fractures in pregnancy are uncommon and present unique challenges related to maternal physiology, fetal safety, and ionizing radiation exposure during operative fixation. The embryo and fetus are sensitive to ionizing radiation at doses greater than 0.1 Gy, although non-cancer health effects are not detectable below this threshold at any stage post-conception (1). Case presentation: We report the case of a 22-year-old primigravida at 20 weeks of gestation who sustained a closed mid-shaft femur fracture following RTA. She underwent closed reduction and intramedullary nailing under image-intensifier guidance using a structured radiation-minimization protocol, including abdominal lead shielding, pulsed fluoroscopy, last-image-hold, and supervision by a senior surgeon. Obstetric monitoring confirmed fetal wellbeing throughout. Postoperatively she received thromboprophylaxis and an early, progressive mobilization program. Conclusion: With a multidisciplinary approach and adherence to the ALARA (as low as reasonably achievable) principle, operative stabilization of a femoral shaft fracture can be performed in pregnancy with an estimated fetal radiation dose far below thresholds associated with adverse effects, and with favorable maternal and fetal outcomes. Early restoration of mobility aligned with pregnancy-specific physical activity guidance supported a healthy remainder of the pregnancy.***

Keywords: femur fracture; pregnancy; fluoroscopy; radiation exposure; intramedullary nailing; ALARA

1. Introduction

Trauma is a leading cause of non-obstetric morbidity in pregnancy, and long-bone fractures requiring operative stabilization are a recognized scenario that brings orthopaedic and obstetric teams together. The use of intraoperative fluoroscopy has become an integral element of contemporary orthopaedic practice, enabling accurate fracture reduction and implant placement (2). However, fluoroscopy also raises concern for both patients and theatre personnel, as staff are exposed unintentionally to X-rays scattered when the primary beam enters the patient, and orthopaedic surgeons as a group may underestimate the cumulative risks of low-dose exposure (3).

These concerns are amplified when the patient is pregnant. Although radiation doses to a fetus tend to be lower than the dose to the mother because of protection from the uterus and surrounding tissues, the human embryo and fetus are sensitive to ionizing radiation at doses greater than 0.1 Gy (1). For the treating team, the challenge is therefore to deliver definitive fracture care without exceeding fetal dose thresholds associated with harm, while also addressing anesthesia, positioning, fetal monitoring, and postoperative recovery in the context of pregnancy.

We present the case of a 22-year-old woman at 20 weeks of gestation with a mid-shaft femur fracture, managed surgically with structured radiation-reduction strategies, and we review the evidence underpinning radiation-safe practice and postoperative mobility in pregnancy.

2. Case Presentation

A 22-year-old primigravida at 20 weeks of gestation (confirmed by second-trimester ultrasound) presented to the emergency department following RTA, complaining of severe pain, swelling, and deformity of the right thigh with inability to bear weight. On examination, she was hemodynamically stable; the right thigh was swollen with obvious shortening and external rotation, and distal neurovascular status of the limb was intact. The abdomen was soft and non-tender, and there was no vaginal bleeding or uterine activity.

Resuscitation and assessment followed a standard trauma approach with left lateral tilt to minimize aortocaval compression. Radiographs of the right femur obtained with the abdomen shielded by a lead apron demonstrated a B2 type (AO/OTA classification) mid-shaft fracture of the femur. An obstetric ultrasound confirmed a single viable fetus with normal anatomy, normal amniotic fluid, and no placental or uterine abnormality was identified. Baseline bloodwork including hemoglobin and coagulation profile was within normal limits.

Given the mechanical instability of the fracture and the maternal and fetal risks of prolonged recumbency and thromboembolism, the decision was made for operative stabilization. A multidisciplinary plan was agreed upon by the orthopaedic, obstetric, and anesthesia teams. Radiation risk was discussed with the patient during informed consent, emphasizing that the estimated fetal dose from a single fluoroscopically guided femoral procedure is well below the 0.1 Gy threshold above which non-cancer health effects become detectable, and that fetal dose estimation considers

the dose to the mother's abdomen as the primary external source.

Surgery was performed under spinal anesthesia with continuous maternal and fetal (FHR) monitoring. A structured radiation-minimization protocol was employed: the maternal abdomen was draped with a lead shield; fluoroscopy was used only in brief pulsed bursts rather than continuous screening (3); last-image-hold was used to review images without re-exposure (4); and a senior surgeon performed the procedure given the demonstrated association between surgical inexperience and increased screening time and radiation dose (4). Total fluoroscopy screening time was 5.61 seconds (Single Pulse shoot), reflecting this protocol. Closed reduction and intramedullary nail fixation was achieved uneventfully. Postoperative radiographs confirmed satisfactory alignment and implant position.

The immediate postoperative course was uncomplicated. Obstetric review confirmed fetal wellbeing with normal fetal heart sounds, and the patient was commenced on thromboprophylaxis and an early mobilization program with protected weight-bearing and physiotherapy. She was discharged on 7th day after adequate rehabilitation and mobilisation with obstetric follow-up planned. At final follow-up, the fracture had united, and the remainder of the pregnancy was uneventful, culminating in spontaneous vaginal delivery at term of a healthy neonate.

3. Discussion

1) Radiation risk to the fetus: thresholds and the 20-week fetus

The potential fetal health effects of ionizing radiation depend on dose and gestational age. In all stages post-conception, radiation-induced non-cancer health effects are not detectable for fetal doses below about 0.10 Gy, and most diagnostic or occupationally regulated exposures fall below this level. At the 14–23 week window, which includes our patient at 20 weeks, non-cancer health effects are considered unlikely at fetal doses of 0.10–0.50 Gy, although growth restriction is possible within this range. Doses greater than 0.5 Gy can produce severe consequences, including growth restriction, malformations, impaired brain function, and cancer. The period from the 8th to the 15th week post-conception is the most vulnerable for radiation-induced intellectual disability, with severe disability possible above 0.5 Gy (5).

Regarding carcinogenic risk, prenatal exposure may increase the risk of cancer in the offspring, particularly at doses above 0.1 Gy, which are well above typical diagnostic radiology exposures (5). For context, the theoretical excess risk of adult-onset cancer from a 0.01 Gy fetal dose- a typical dose from a CT of the abdomen and pelvis- is likely less than 1 in 1,000. In fracture fixation, measured patient doses are modest: one series reported a median dose-area product of 2.58 Gy·cm² for dynamic hip screw fixation and 0.39 Gy·cm² for ORIF of the ankle, with median screening times of 0.90 and 0.55 minutes (4). Such values, combined with abdominal shielding and restricted screening, keep the estimated fetal dose orders of magnitude below the 0.1 Gy threshold.

2) Strategies to minimize radiation exposure

Radiation exposure cannot be eliminated, but it can be minimized using the ALARA principle. Key protective measures used in our case are supported by the literature:

a) **Shielding:** Lead aprons reduce exposure by a factor of 4 in the lateral view and a factor of 16 in the postero-anterior view, and should have at least 0.5 mm lead equivalent thickness (3). For the pregnant patient herself, abdominal lead shielding directly reduces fetal dose.
b) **Screening technique:** Pulse mode decreases radiation dose by 70%, and intermittent 3-second bursts with long "off" intervals should replace continuous fluoroscopy (3). Image capture and memory storage allow image review without re-exposing the patient, and snapshot pulsed fluoroscopy with last-image-hold is endorsed as a dose-optimization measure (4).
c) **Distance and position:** The intensity of radiation is inversely proportional to the square of the distance from the source, and personnel should maintain a minimum distance of 18 inches from the zone of the primary beam. Because the surgeon's proximity to the source results in the greatest received dose, staff should increase their distance where possible. In orthopaedic procedures, scatter is maximal in the backward direction, and directing the beam from medial to lateral has been proposed to reduce operator exposure.
d) **Surgical experience:** The experience of the operating surgeon is one of the most important factors determining screening time and patient dose during fluoroscopically assisted fracture fixation, and involvement of senior surgeons significantly reduces both radiation dose and screening time.

These measures have relevance not only to the pregnant patient but to all theatre staff, since without lead protection, continual occupational exposure may breach the 1 mSv yearly limit for certain positions.

3) Counseling and shared decision-making

Counseling the expectant mother about radiation risk must balance risk and benefit within the broader context of preventive healthcare during prenatal care. Effective communication should account for the patient's educational background, language and cultural factors, and the level of stress and psychological influences present. In our patient, an early, transparent discussion of the estimated fetal dose, the indications for surgery, and the protective measures planned enabled informed consent and reduced anxiety. This approach mirrors broader calls to empower pregnant women through knowledge, skills, and supported decision-making (6).

4) Postoperative recovery and mobility in pregnancy

A further consideration in this case was the restoration of mobility. Walking is the most commonly chosen type of physical activity during pregnancy and offers well-documented benefits, including a cumulative 20% decreased risk of gestational diabetes mellitus, a 33% decreased risk of preeclampsia, and reduced excessive gestational weight gain (7). In the context of labor, freedom of movement and positioning facilitates safe progression, improves maternal and neonatal outcomes, and contributes to a positive birth experience (6); policies that encourage walking or position changes in labor may result in shorter labors, more efficient

contractions, greater comfort, and less need for pain medication — with no study demonstrating harm from walking in healthy women (8). Restricting women's movement may worsen birth outcomes and decrease satisfaction (8). Early protected mobilization and physiotherapy after femoral fixation therefore served a dual purpose: preventing the complications of immobility and preserving the general health benefits of activity in pregnancy.

4. Conclusion

Antenatal status should not, by itself, be considered a contraindication to surgical management of fractures. Conservative treatment may appear preferable because it avoids exposure to ionizing radiation, anesthetic agents, and potential intraoperative complications, particularly during early pregnancy. However, in lower-extremity trauma, prolonged immobilization and immediate restriction of joint movement may significantly compromise maternal mobility. Maintaining mobility during pregnancy is important for routine antenatal care, functional independence, and preservation of adequate hip and knee range of motion, which may also facilitate normal vaginal delivery. Thus, when fracture characteristics require definitive fixation, the potential benefits of early mobilization should be balanced against the theoretical risks of anesthesia and radiation rather than pregnancy being considered an absolute reason to avoid surgery. Operative fixation of a mid-shaft femur fracture at 20 weeks of gestation can therefore be performed safely when orthopaedic, obstetric, and anesthesia teams collaborate around a structured radiation-minimization protocol. With fetal radiation exposure kept well below 0.1 Gy through abdominal shielding, pulsed fluoroscopy, distance discipline, and senior surgical supervision, the risk of radiation-related fetal harm is minimal (Radiation and Pregnancy: Information for Clinicians, 2025). Early restoration of mobility additionally supports the established benefits of physical activity during pregnancy (Connolly et al., 2018). This case illustrates that definitive orthopaedic treatment and fetal safety are not mutually exclusive when appropriate patient selection and evidence-based radiation and perioperative precautions are employed.

Take-Home Message

- **Harm thresholds:** Non-cancer fetal effects are not detectable below ~0.1 Gy at any post-conception stage; at 14–23 weeks (including a 20-week fetus), effects are unlikely below 0.5 Gy (1).
- **Follow the ALARA principle:** use lead shielding (0.5 mm Pb minimum), pulse mode (−70% dose), intermittent 3-second fluoroscopy bursts, image capture and last-image-hold, and distance from the primary beam (3).
- **Senior surgeon, less radiation:** surgical experience is a key determinant of screening time and dose; senior involvement significantly reduces both (4).
- **Counsel early and transparently** with the expectant mother, supporting her informed decision-making at each step (6).
- **Restore mobility early:** protected weight-bearing after fixation preserves the benefits of walking in pregnancy, including reduced risks of gestational diabetes (−20%) and preeclampsia (−33%) (7), and active mobilization aligns with evidence that movement improves labor outcomes (8).

References

[1] Centers for Disease Control and Prevention. Radiation and pregnancy: information for clinicians. Radiation Emergencies. Atlanta, GA: CDC; 2025 Jan 31.
[2] Dorman PJ, Drever N, Plumridge R, Gregory J, Cooper R, Rod... Radiation dose to staff from medical X-ray scatter in the orthopaedic theatre. Eur J Orthop Surg Traumatol. 2023.
[3] Mahajan A. Occupational radiation exposure from C-arm fluoroscopy during common orthopaedic surgical procedures and its prevention. J Clin Diagn Res. 2015.
[4] Botchu R, Ravikumar K. Radiation exposure from fluoroscopy during fixation of hip fracture and fracture of ankle: effect of surgical experience. Indian J Orthop. 2008.
[5] National Council on Radiation Protection and Measurements. Preconception and prenatal radiation exposure: health effects and protective guidance. NCRP Report No. 174. Bethesda, MD: National Council on Radiation Protection and Measurements; 2013.
[6] Lopes R, Vieira M, Cardoso... Empowering women in decision-making about mobility during labor: insights from experts. Eur J Midwifery. 2025.
[7] Connolly CP, Conger SA, Montoye AHK, Marshall MR, Schlaff RA, Bad... Walking for health during pregnancy: a literature review and considerations for future research. J Sport Health Sci. 2018.
[8] Shilling T, Romano AM, DiFranco JT. Care practice #2: freedom of movement throughout labor. J Perinat Educ.2007.

Images

Figure 1: Preoperative radiograph of a femoral shaft fracture in pregnancy. Preoperative anteroposterior radiograph demonstrating a displaced, comminuted mid-shaft fracture of the right femur.

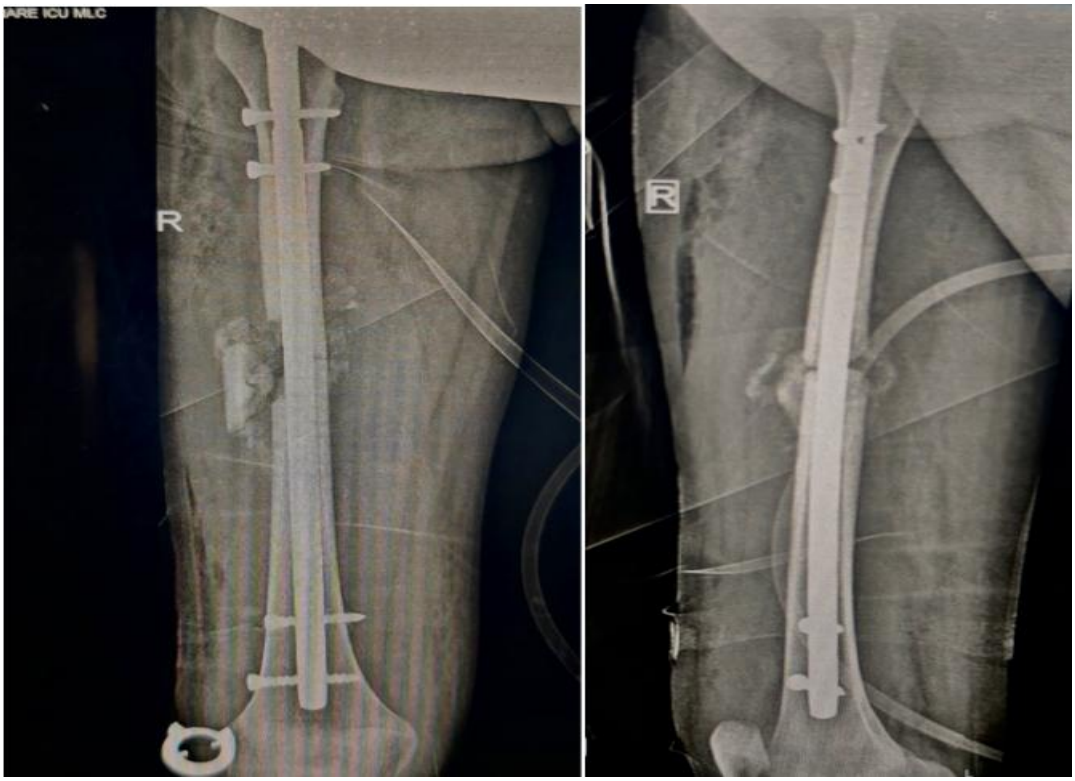

Figure 2: Postoperative radiographs of a femoral shaft fracture in pregnancy. Postoperative anteroposteriorand lateral radiographs demonstrating fixation with a locked intramedullary femoral nail, with improved alignment and appropriate positioning of the implant

List of Abbreviations

Abbreviation	Full term
RTA	Road Traffic Accident
ALARA	As low as reasonably achievable
CT	Computed tomography
DAP	Dose-area product
GDM	Gestational diabetes mellitus
ORIF	Open reduction and internal fixation
PA	Postero-anterior
AO/OTA	Arbeitsgemeinschaft für Osteosynthesefragen / Orthopaedic Trauma Association
Abbreviation	Full term
RTA	Road Traffic Accident
ALARA	As low as reasonably achievable
CT	Computed tomography
DAP	Dose-area product
GDM	Gestational diabetes mellitus
ORIF	Open reduction and internal fixation
PA	Postero-anterior
AO/OTA	Arbeitsgemeinschaft für Osteosynthesefragen / Orthopaedic Trauma Association

Declarations

Ethics Approval and Informed Consent: This case report was conducted in accordance with the ethical standards of Institution and the Declaration of Helsinki. Written informed consent was obtained from the patient for publication of this report and any accompanying images.

Conflict of Interest: The authors declare that they have no competing interests.

Funding: This work received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Acknowledgments: The authors thank the members of the Department of Orthopaedic, Obstetric & Gynecology, Anesthesia, Radiology and nursing staff involved in the patient's care.