AN INNOVATIVE BIOMECHANIC TECHNIQUE OF TOTAL HIP ARTHROPLASTY IN SICKLE CELL DISEASED HIP PATIENTS WITH FEMORAL CANAL STENOSIS

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DECLARATION

I have no competing financial interests or personal relationships that could have appeared to influence the work reported in this presentation.

OBJECTIVE

To describe femoral preparation technique for cementless Total Hip Arthroplasty in Sickle Cell Disease patients with narrow femoral canal.

SCOPE

- Summarize current evidence on THA outcomes in SCD with narrow femoral canals.
- Select appropriate femoral component placement for narrow canals.
- **Propose an innovative technique in THA Femoral Component placement in SCD patient with a narrow canal.**
- Identify key peri-operative risk mitigation strategies.

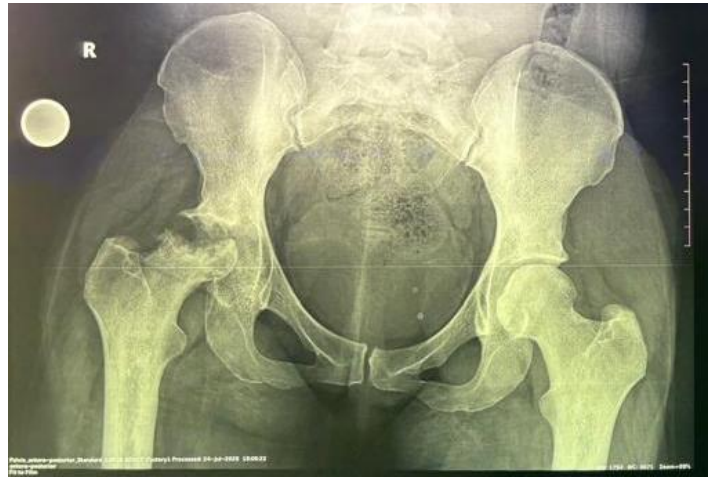
BACKGROUND

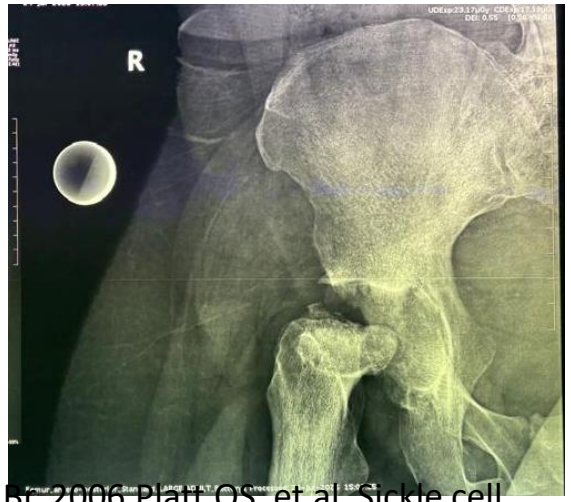
Sickle Cell Disease (SCD) is prevalent in West Africa. (1.3 - 6.8%).

- Secondary OA is commonly due to Osteonecrosis of femoral head with recurrent marrow infarction (10-20 %)
- THA often required in young patients
- Surgery is technically demanding and medically high-risk.

PATHOPHYSIOLOGY

- Chronic marrow hyperplasia → endosteal bone formation
- Repeated infarction → medullary sclerosis “Femur-within-femur” appearance.
- Patchy canal obliteration





Radiological Features:

- Narrow, irregular canal
- Thin cortices with focal sclerosis

Hernigou P, et al. Natural history of symptomatic osteonecrosis in adults with sickle-cell disease. J Bone Joint Surg Br. 2006.Platt OS, et al. Sickle cell disease. N Engl J Med. 1994.Mukisi-Mukaza M, et al. Osteonecrosis of the femoral head in sickle-cell disease. Int Orthop. 2009.

SIGNIFICANCE OF A NARROW CANAL IN ARTHROPLASTY

- Difficult canal entry.
- Broach/reamer deflection.
- Poor metaphyseal fit.
- Increased: Intra-operative fractures
  Malalignment
  Early loosening

OUTCOMES OF THA IN SCD

Systematic reviews of Level III to V Evidence show (2017 – 2024):

- Significant pain relief and functional improvement.
- Higher complication rates in SCD THA vs Non-SCD THA patients.

- Common complications
  - Aseptic loosening
  - Prosthetic joint infection (PJI)
  - Intra-operative femoral fracture
  - Medical crises (VOC, ACS)

Issa K, et al. Outcomes of total hip arthroplasty in sickle-cell disease. EFORT Open Rev. 2017.Zhan Y, et al. Total hip arthroplasty in sickle cell disease: systematic review and meta-analysis. J Orthop Surg Res. 2024.Huo MH, et al. Survivorship of THA in sickle-cell patients. Clin Orthop Relat Res. 2009

OPERATIVE GOALS

The goal is to find a technique that offers:

Safe femoral canal preparation;

Stable stem positioning without intra-op fracture/perforation.

Prevention of sequalae eg Ischaemia, collapse and aseptic loosening.

Ability to use available and customized implants.

In THA in SCD. decision points are: (cemented vs uncemented), geometry of femoral stem choice, technique canal preparation and peri-op medical optimization.

CEMENTED VS UNCEMENTED STEMS

Cemented Stems

- Thermal necrosis
- Higher loosening in young patients

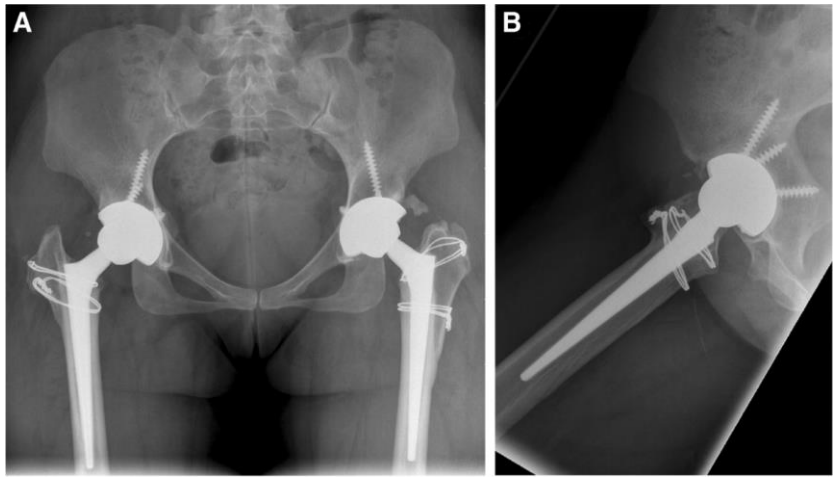
Uncemented Stems

- Favoured in younger SCD patients
- Risks:
  - Fracture during broaching
  - Difficulty achieving press-fit in narrow canals

Recommendation: Uncemented Stems in SCD THA

FEMORAL STEM SELECTION IN NARROW CANALS

- Recommended options (based on reviews and expert consensus):
- Small-diameter stems
- DDH-type narrow stems
- Tapered wedge stems (↓ hoop stress)
- Cylindrical distal-fixation stems
- Cone stems (e.g. Wagner-type) in extreme deformity



CANAL PREPARATION TECHNIQUES

Best-supported techniques:

- Entry with:4.5–6 mm drill bit.
- High-speed burr.
- Cannulated/flexible reaming over guidewire.
- Fluoroscopy when available.
- Cortical window in focal canal obliteration.
- Prophylactic cerclage wiring after reaming.

PERI-OPERATIVE MEDICAL OPTIMIZATION

- Avoid hypoxia, hypothermia, acidosis, dehydration.
- Adequate analgesia.
- Early mobilization.
- Transfusion: Pre-operative transfusion recommended for: HbSS patients, Major orthopaedic surgery.
- ? Exchange transfusion for high-risk cases.

A BIOMECHANIC TECHNIQUE OF THA FEMORAL COMPONENT PLACEMENT IN SICKLE CELL DISEASE OA HIP PATIENTS WITH FEMORAL CANAL STENOSIS

PATIENT SELECTION

Indications:

- SCD patients with Advanced Hip Osteoarthritis and narrow proximal femoral canal that the smallest conventional cementless femoral implant would not fit.
- Stable hemoglobin: No more than two medical admissions in a year

Contraindications:

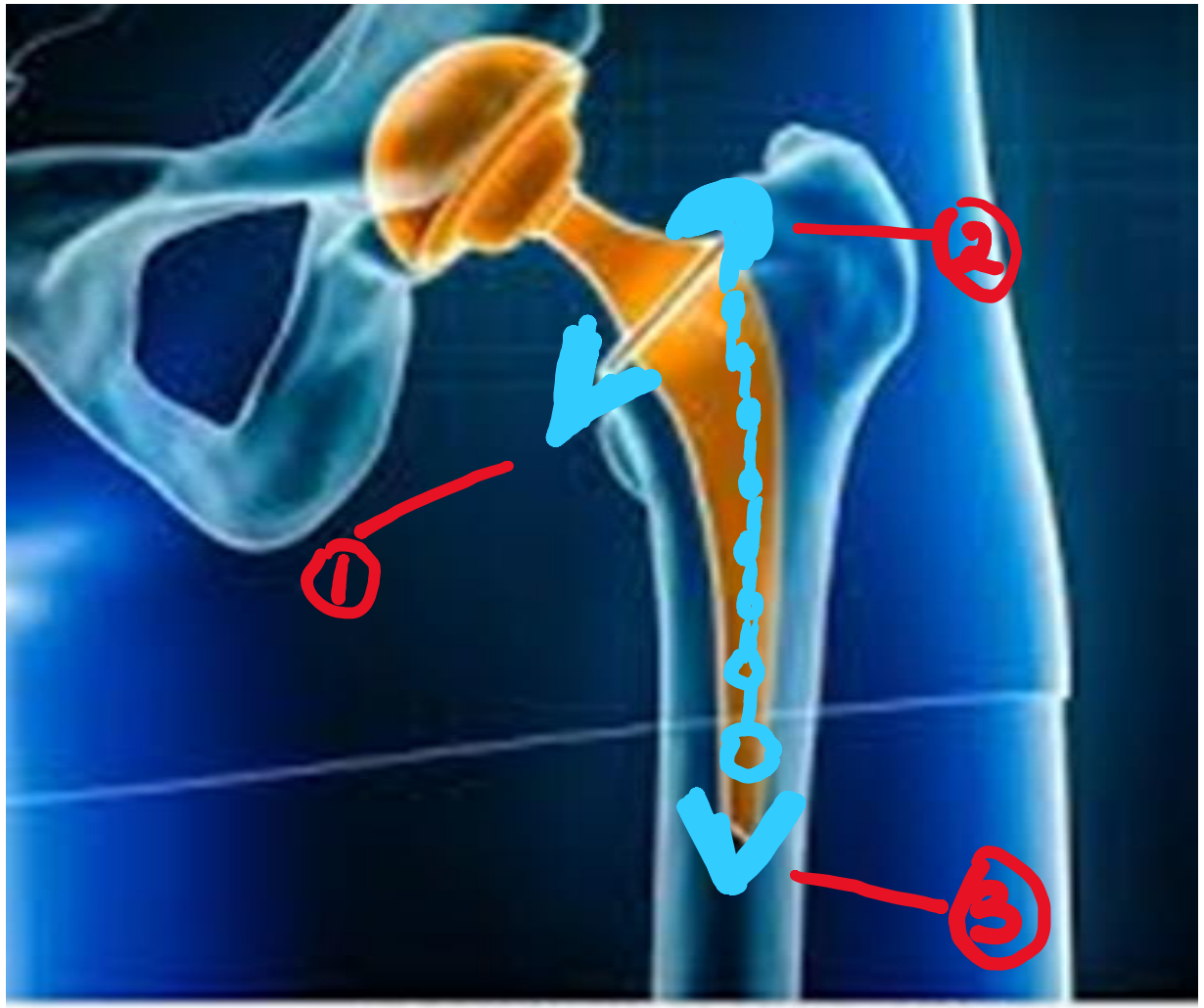
- Active infection
- Poorly optimized SCD patient

SURGICAL TECHNIQUE -TEMPLATING

Standard templating of the Acetabulum Component.

Standard templating of Femoral component :

- Canal shape & size.
- Templating will demonstrate that smallest femoral implant cannot be suitable for press fit.
- It is essential to have standard radiographs with known magnification.

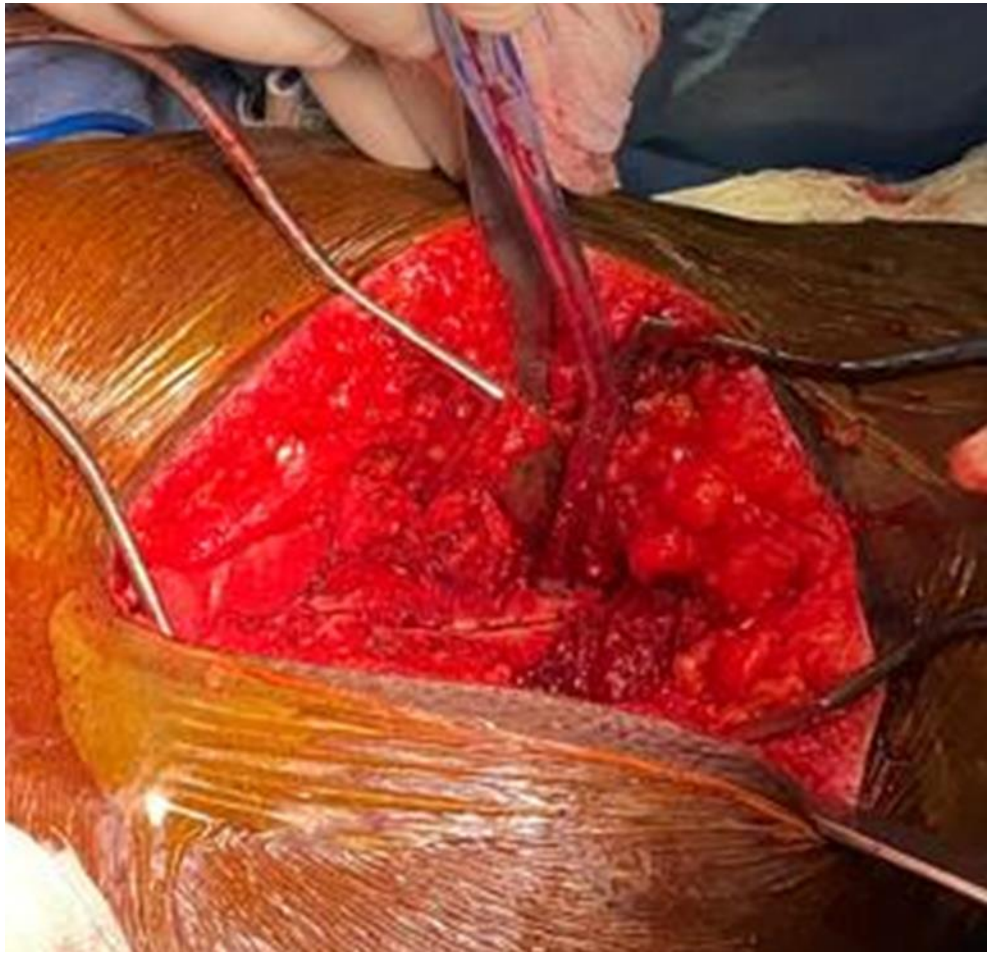


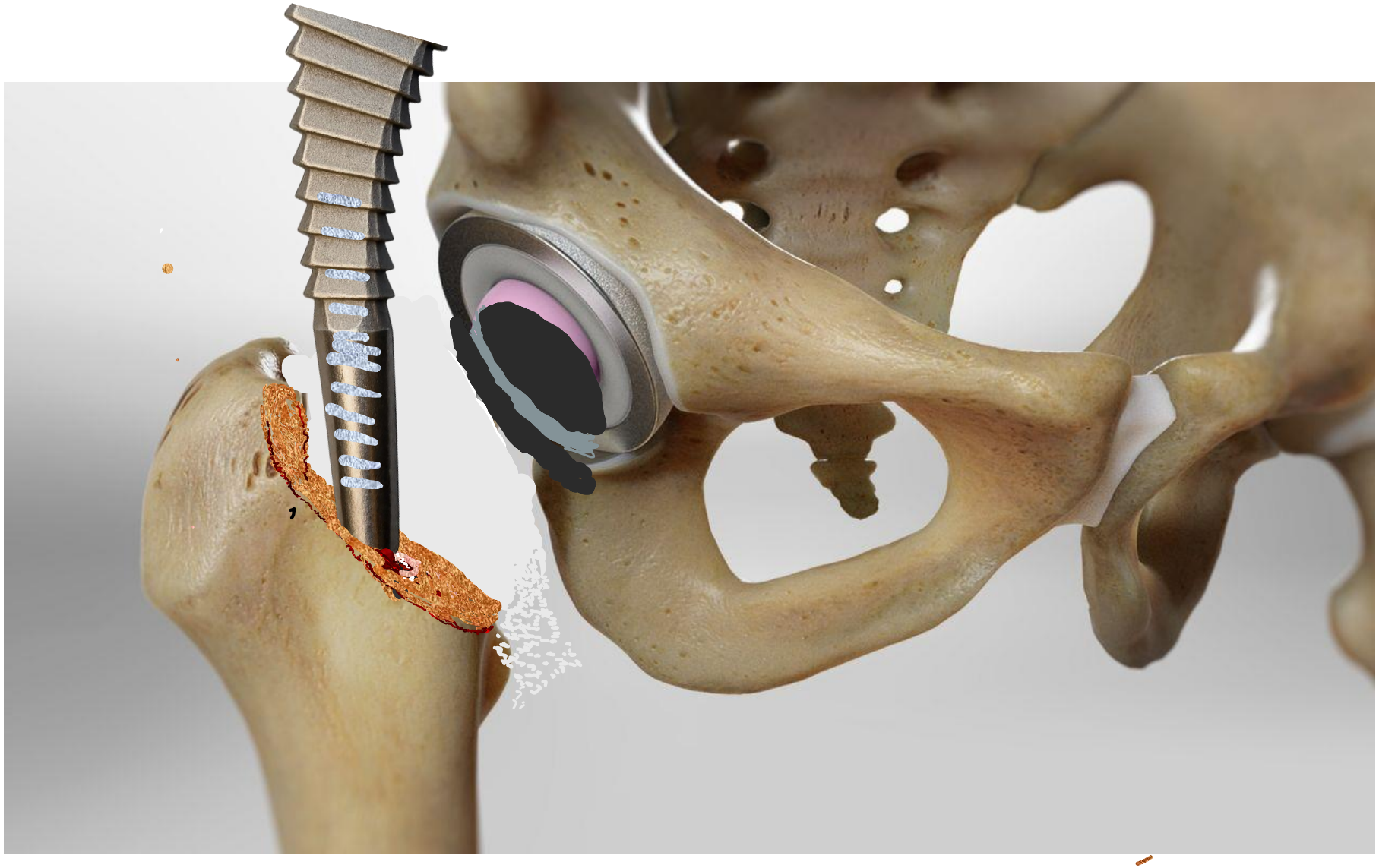
3 –Point Contact of the stem in the proximal femur

SURGICAL TECHNIQUE- FEMORAL PREPARATION

Exposure & Preparation:

- Anterolateral Approach to the hip.
- Standard femoral neck osteotomy.
- Standard Acetabular preparation
- Find femoral canal and attempt manual reaming to confirm narrow canal intra-op.
- Exposure of the anterior surface of the proximal femur.

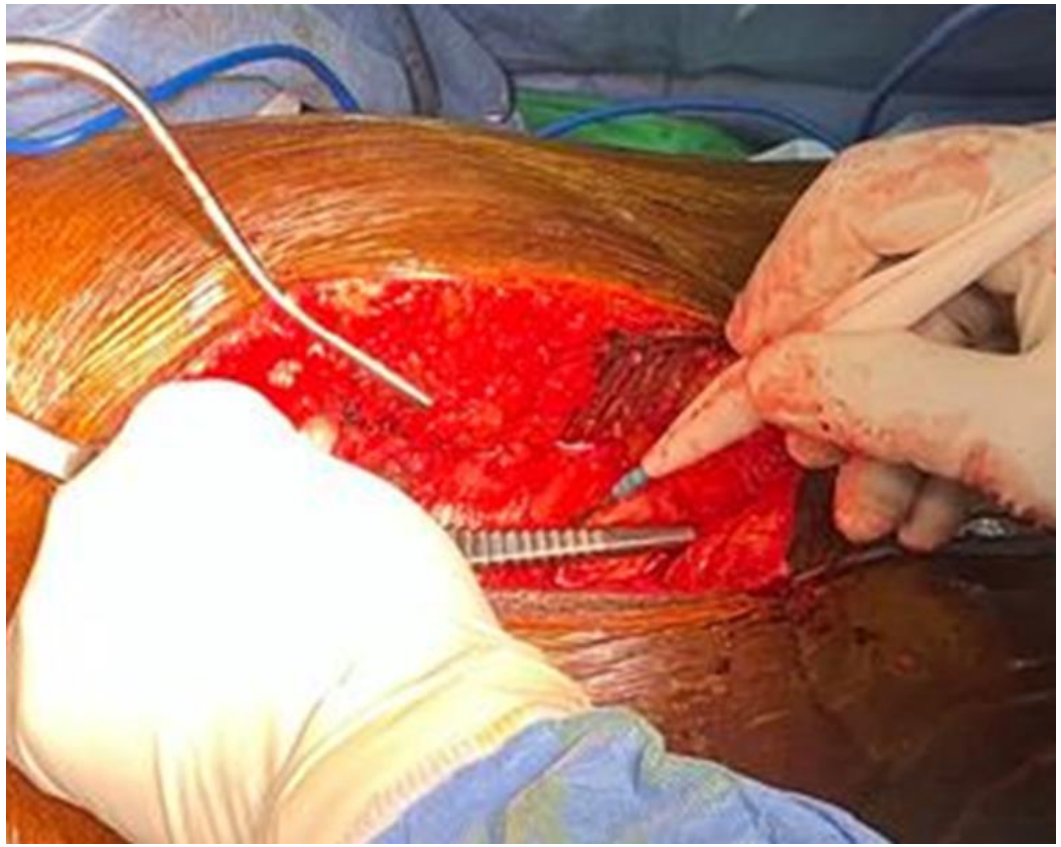


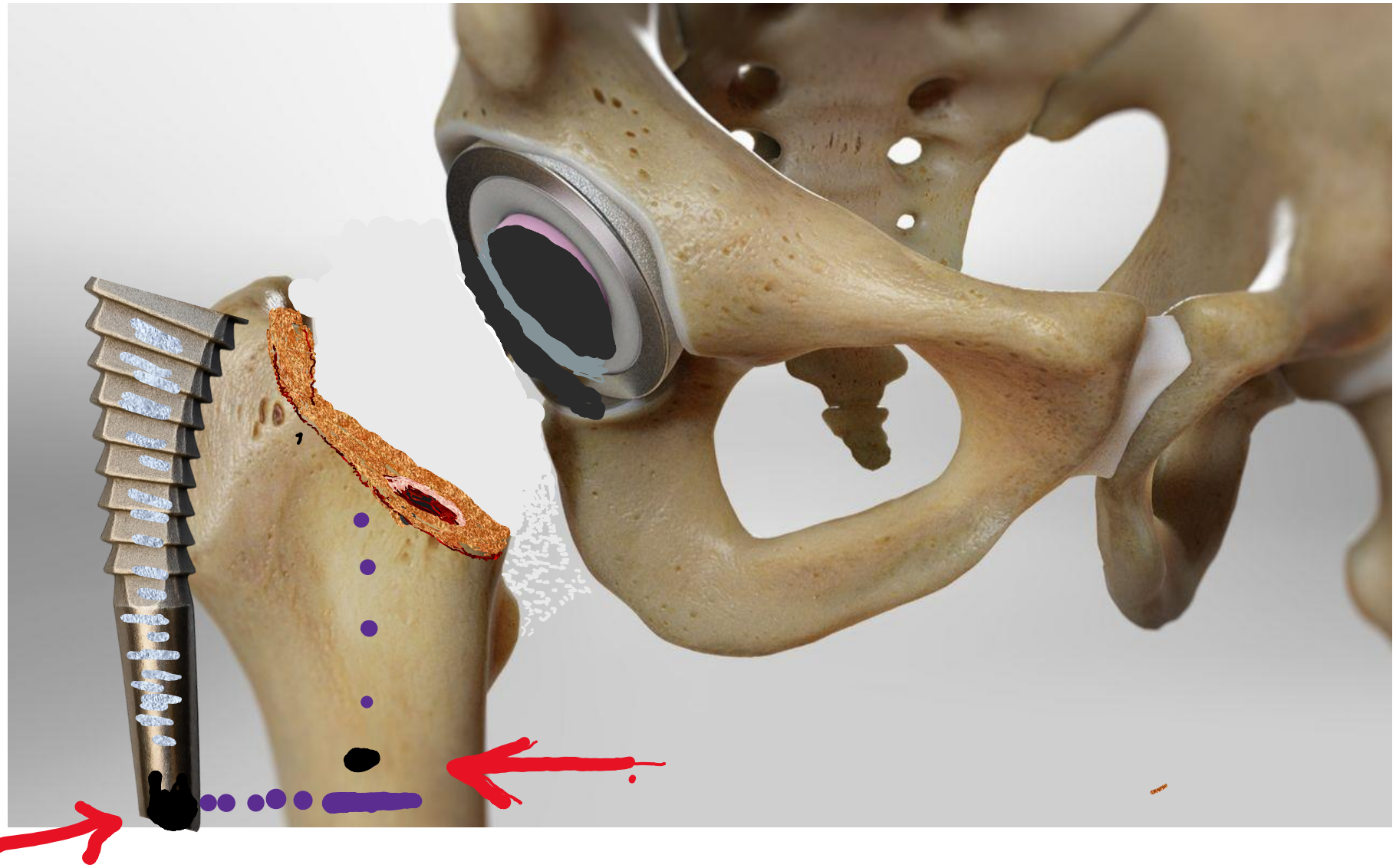


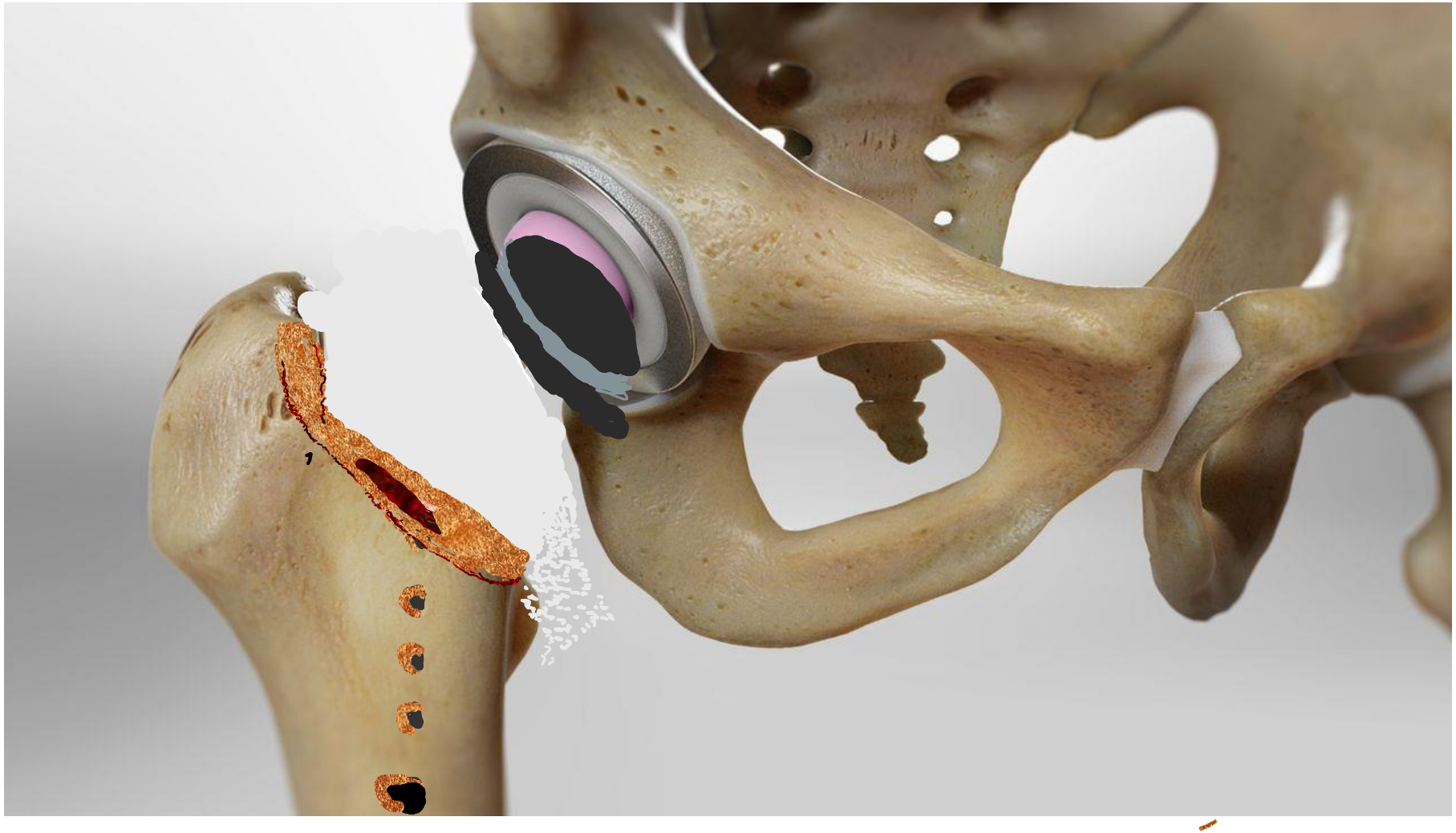
SURGICAL TECHNIQUE – LONGITUDINAL OSTEOTOMY

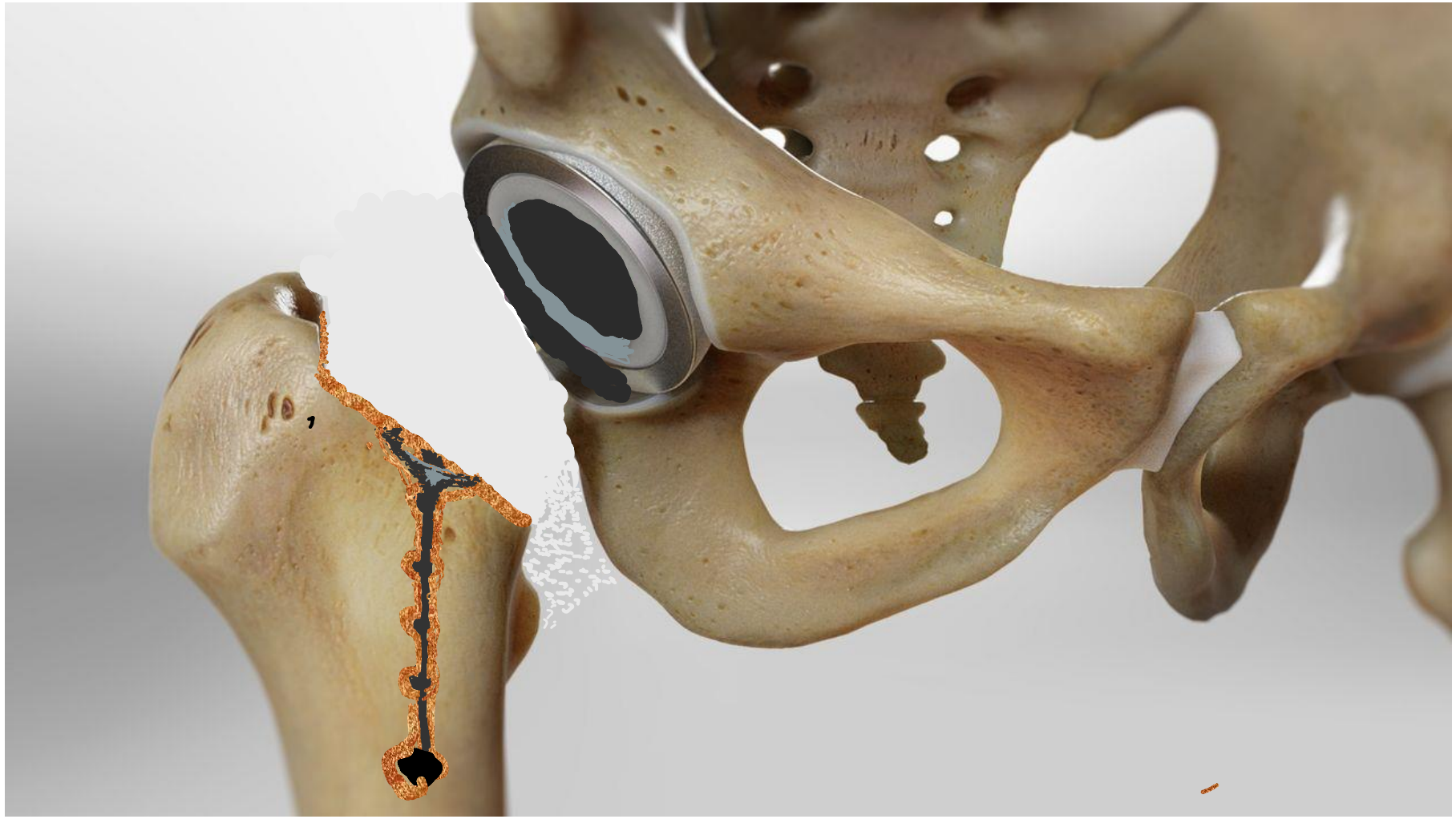
Marking of Osteotomy Site

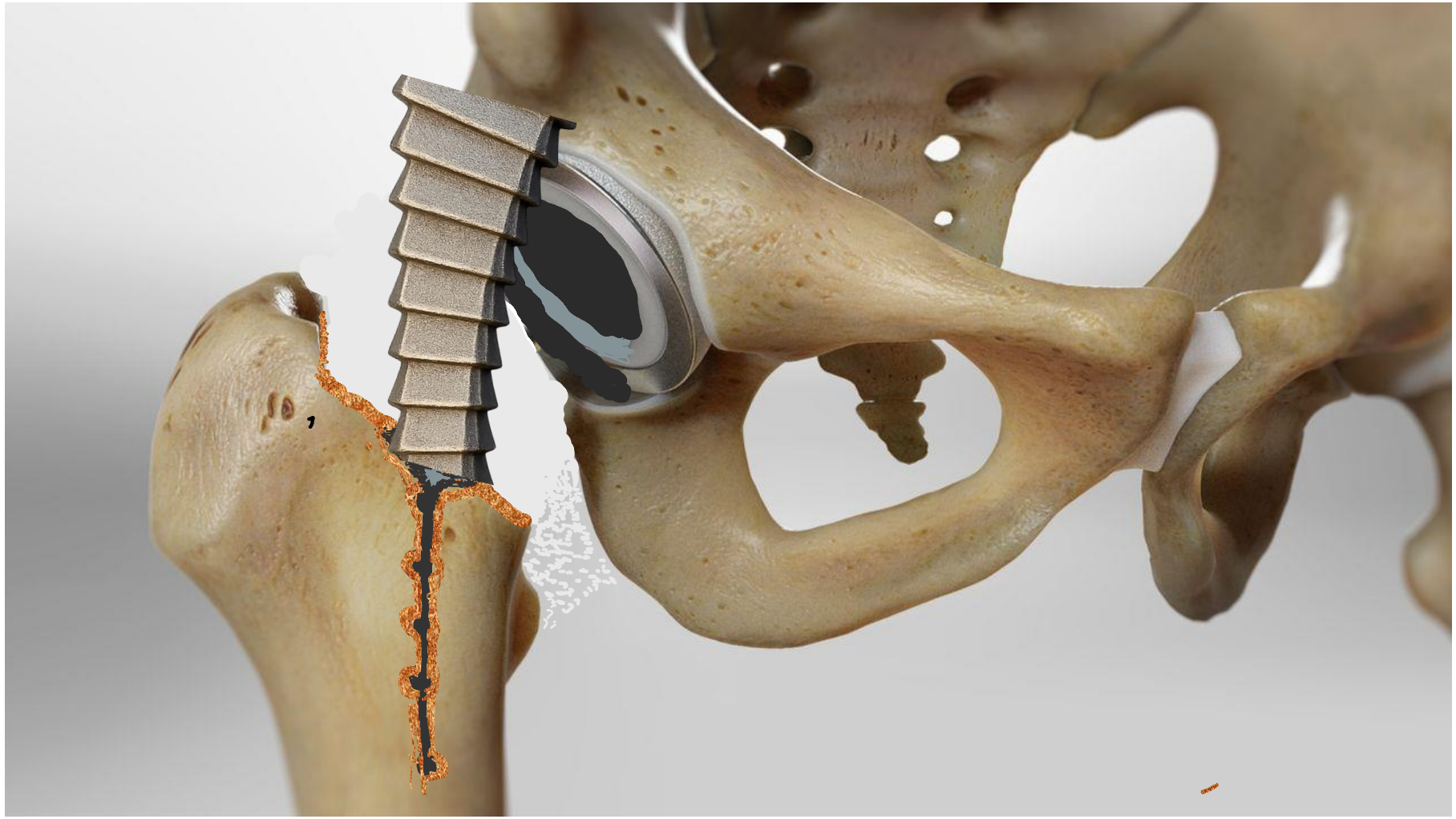
- Determine the estimated length of femur to be split using a rasp stem as a guide.
- Create drill holes along intended line of osteotomy.
- Performed with oscillating saw/osteotome.
- Longitudinal Split should be confined confined to proximal femur and limited by a large distal drill hole.











SURGICAL TECHNIQUE – TRIAL INSERTION

Trial Insertion, Stabilization and Reduction.

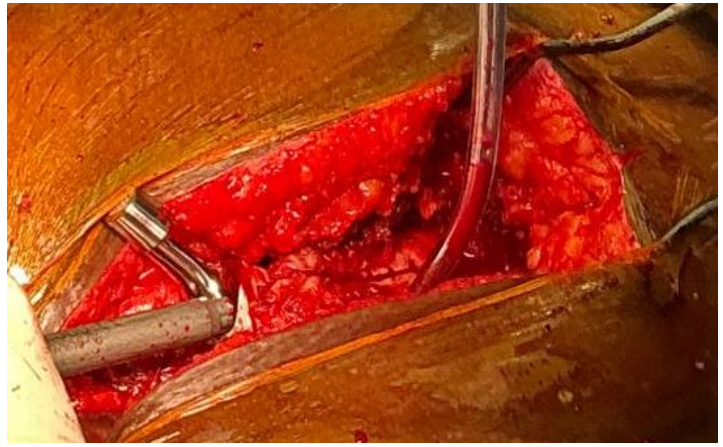
The last drill hole is made wider to minimise the risk of the osteotomy ‘jumping’ distally uncontrolled,

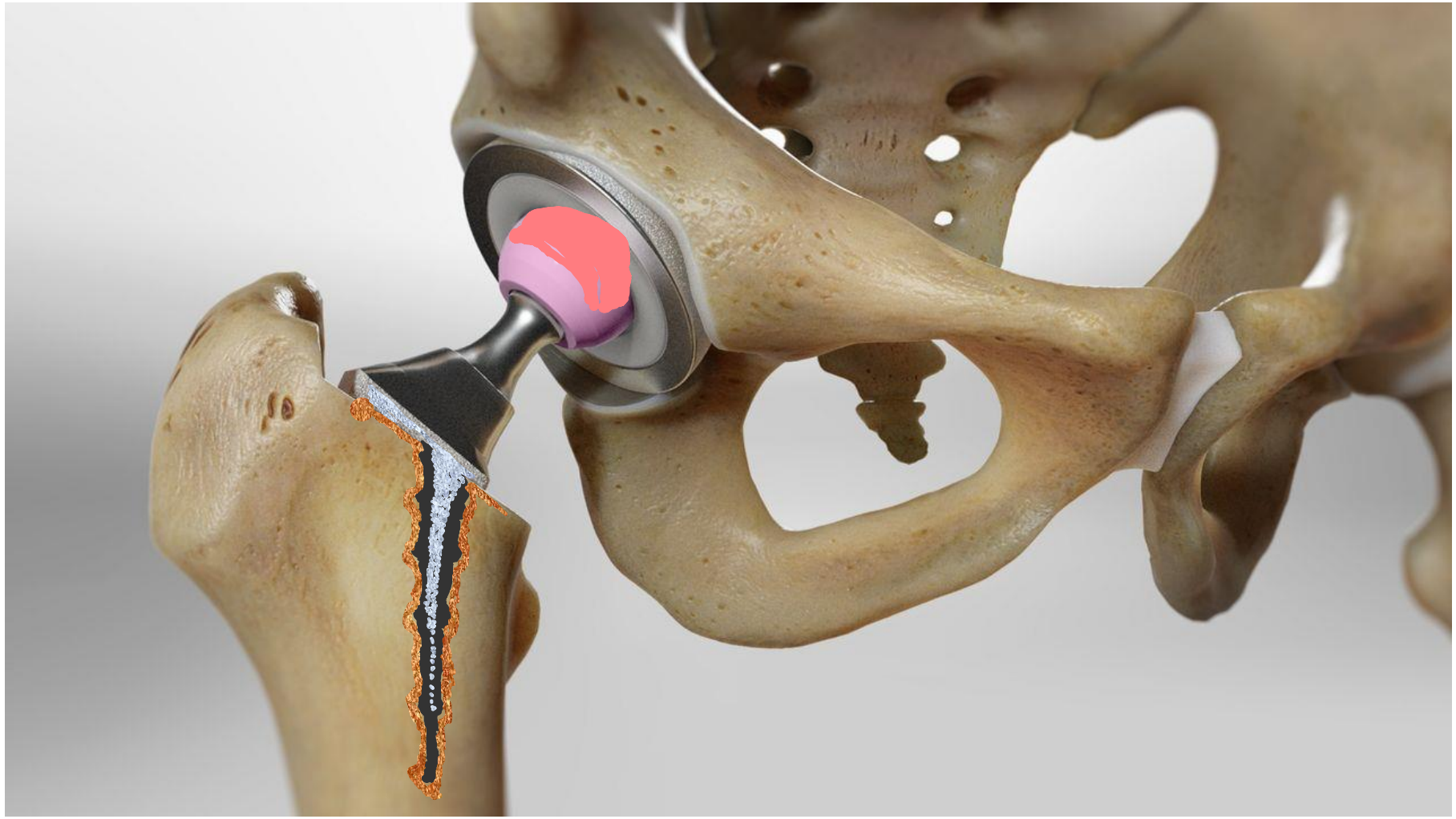
- The smallest rasp/ trial stem is inserted in the osteotomized femur, stabilized with cerclage wire and reduced.
- If satisfactory, trials removed and formal implants implanted, stabilise with cables or wires if necessary.

SURGICAL TECHNIQUE – STEM INSERTION

Stem Insertion & Stabilization:

- Standard smallest stem (Size 0) inserted without over-reaming.
- As stem is being impacted careful inspection of the widening longitudinal split is done as observed with the rasp.
- If further extension of the latitudinal split is need, more holes are drilled and controlled split extended.
- Care is taken to ensure required length of uncemented coated stem is inserted with the required version as per trial.

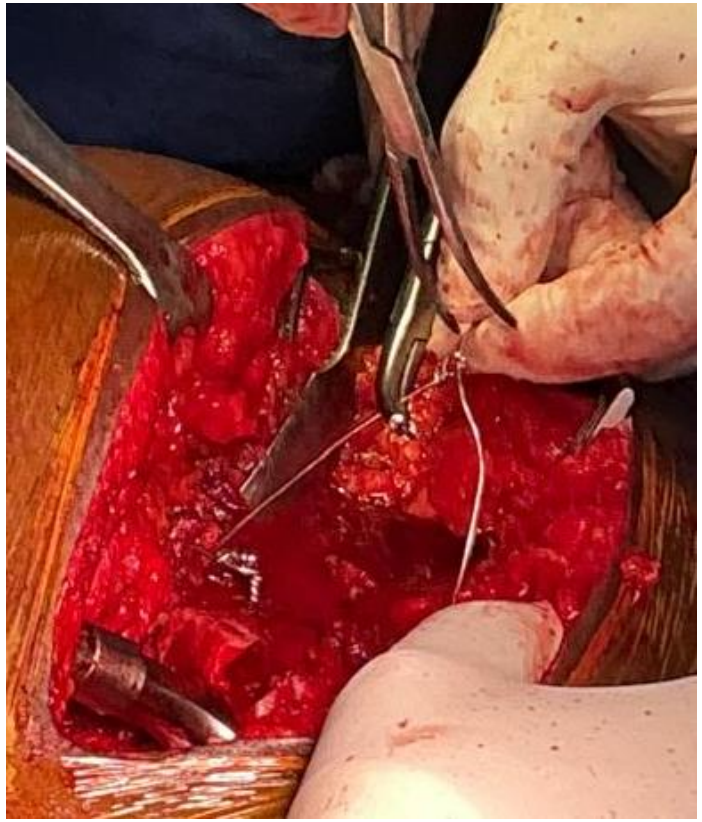




SURGICAL TECHNIQUE - STABILIZATION

Stabilization of the Proximal Femur:

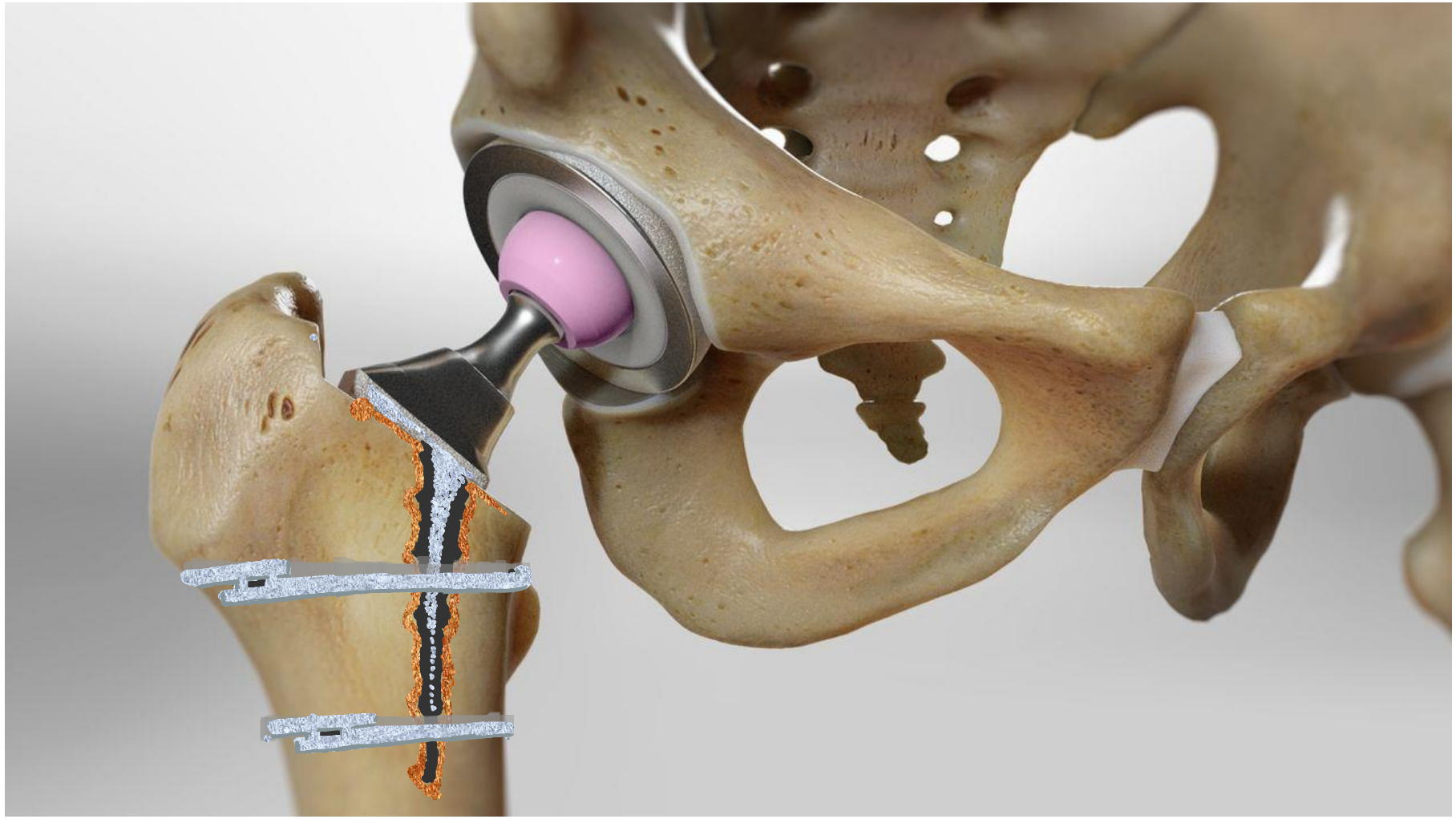
- Stem must be stable to prevent migration (subsidence) and rotation and tuggling.
- Cables/cerclage wires applied to the stem preferrable at 2 levels over the longitudinal split to prevent propagation of the split if necessary.



SURGICAL TECHNIQUE – HIP REDUCTION AND STABILITY

Hip Reduction and Standard Stability Assessment:

- Hip is reduced and the standard assessment for stability is done.
- Soft tissue repair done in layers.
- Standard repairs and wound closure done.



PROS / ADVANTAGES

- Minimises ultra-narrow stems breakage
- Eliminates over-reaming → preserves vascularity
- Allows use of standard implants
- Provides stable fixation

MINIMISING COMPLICATIONS

NOTABLE CONCERNS AND RISKS

- Intraoperative haemorhage may be more than usual.
- Risk of split propagation distally
- Risk of implant rotating in the femoral canal
- Risk of implant protruding out of the proximal part of the split
- Risk of shattering the proximal femur
- Postoperative delayed weight-bearing (about 2-6 weeks) delays rehabilitation.
- Non-union of the split (Controlled Longitudinal Osteotomy.)

POST OPERATIVE PROTOCOL

- Partial weight-bearing for about 6 weeks.
- Gradual mobilization with physiotherapy.
- SCD-specific care: hydration, anticoagulation, analgesia.

DISCUSSION

- Practical solution for narrow canal in SCD patients.
- Preserves bone stock, reduces implant failure risk.
- Balances stability with biological safety.
- Requires surgical expertise.

CONCLUSION

- Controlled femoral split with cerclage reinforcement is:
- Safe
- Effective
- Reproducible
- Safe outcome

- Viable solution for complex THA in SCD patients with femoral canal stenosis

ACKNOWLEDGMENTS

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- Patents
- Military Hospital. Ghana
- WCORT 2025 Organizers

Literature

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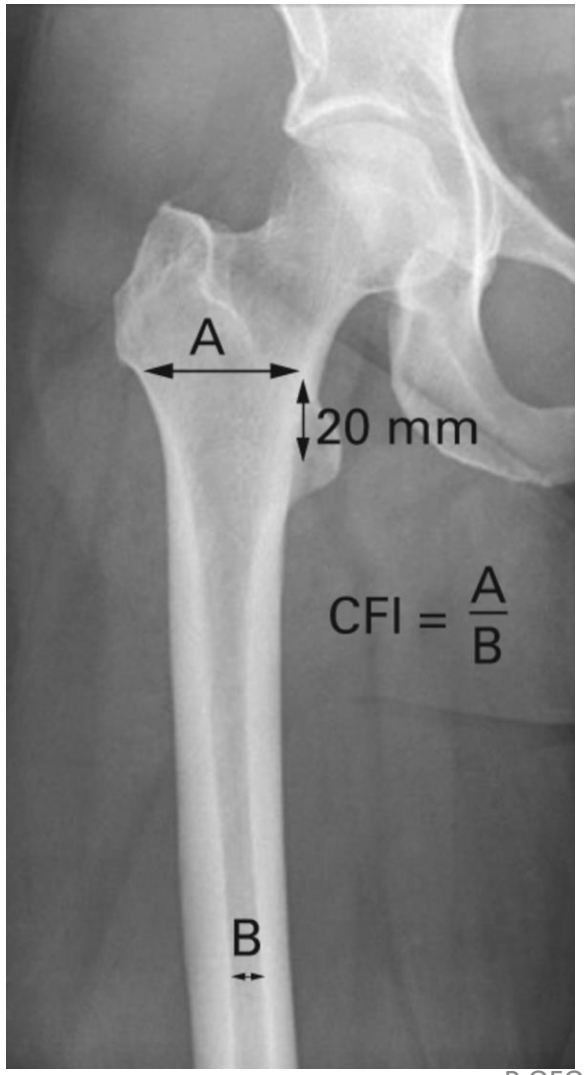
- 2. Radiographic evaluation of the proximal femur in sickle cell disease patients Akintun et al
- 25th Annual Meeting of European Research Society 13thSeptember, 2017GK Yeong J Am Acad Ortho Surg 2005 May-Jun 13(3) 208-17
- 3 Hackman et al. Results and complications of total hip arthroplasties in patients with sickle cell hemoglobinopathy. J Arthroplasty 1997 (12) 420-425
- 4 Aetiology, Outcomes and Complications of Total Hip Arthroplasty in Younger Patients. Maman et al J Clinical Med 2024 Aug 2:13(15)4334
- 4 Treatment for avascular necrosis of bone in people with sickle cell disease Arturo et al (12) CD00004344

THANK YOU

MERCI BEAUCOUP

TRADITIONAL LANDMARKS OF DORR CLASSIFICATION



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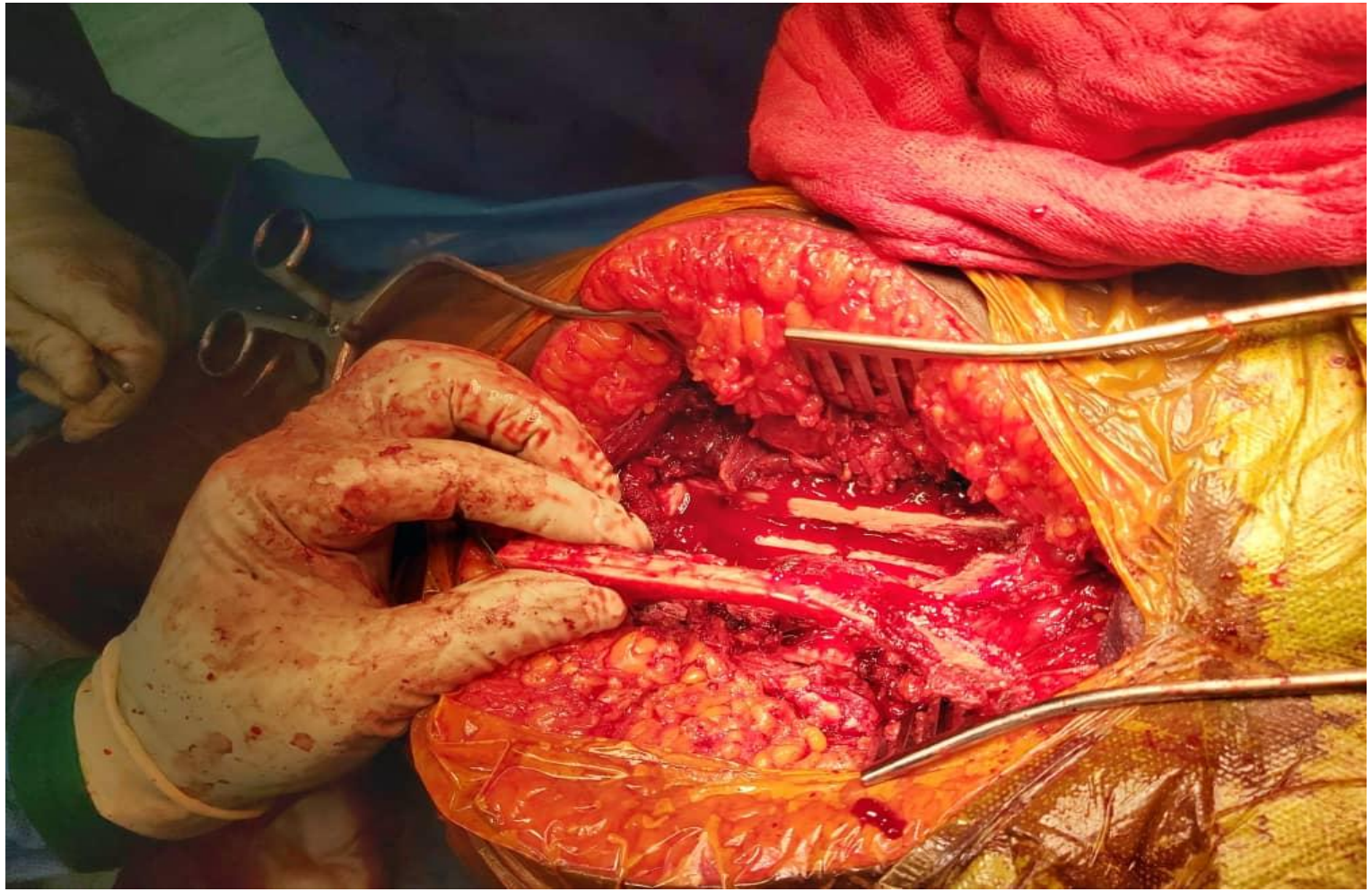
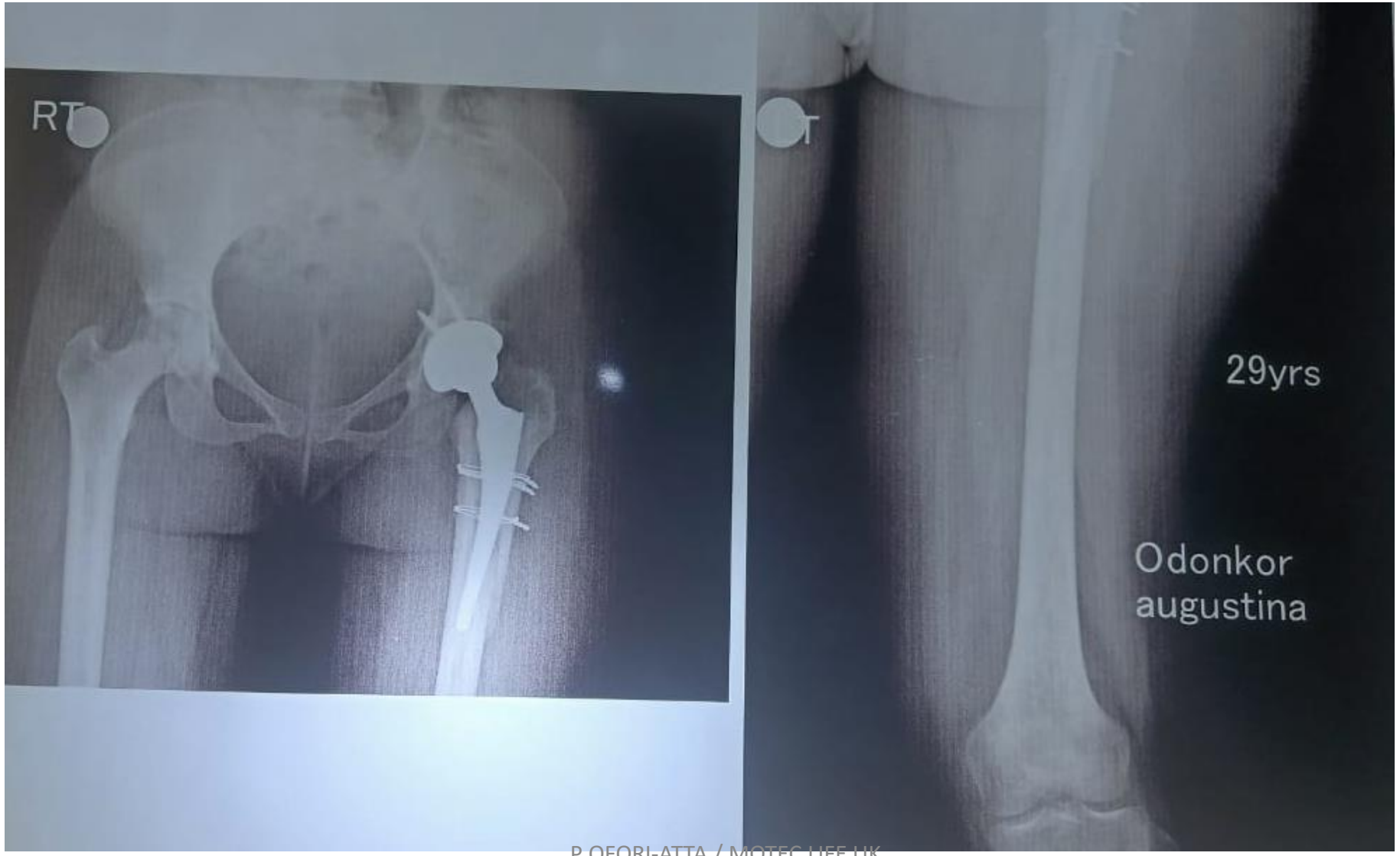
INTRA-OPERATIVE FEMORAL OSTEOTOMY OTHER WAYS



A distal fracture proximal to the tip of implant



- Total hip arthroplasty (THA) for Developmental Dysplasia of the Hip (DDH) often requires specialized femoral stems due to a narrow, deformed, and frequently high-riding (Crowe III or IV) medullary canal. These stems are designed with smaller diameters, tapered geometries, and sometimes modularity to address excessive femoral anteversion and the small, straight proximal femur.
- Commonly Used "DDH Type" Narrow Stems:
- Wagner Cone Prosthesis (Zimmer): Often considered the gold standard for high-degree DDH (Crowe IV), this cementless, conical, tapered stem is designed to fit narrow medullary canals. Its tapered shape allows for free setting of anteversion.
- Modular Stems (e.g., S-ROM, DePuy): These allow for the independent adjustment of the proximal and distal stems to accommodate severe anteversion and narrow, distal, straight canals.
- Modified S-ROM-A (Asian Specific): Developed for narrower canals in Asian populations, this stem has a 1-mm incremental diameter (rather than the standard 2-mm) to prevent periprosthetic fractures.
- Small Cemented Components: Used when the canal is too narrow or weak for cementless options.
- Customized Stems: Manufactured for cases with severe proximal femoral deformity that cannot be addressed by off-the-shelf options.
- Key Anatomical Challenges and Solutions:
- Narrow Medullary Canal: Requires small diameter stems (<9mm) to prevent intraoperative fractures.
- Excessive Anteversion: Addressed by using tapered or conical stems, or modular systems that allow independent version control.
- High Dislocation (Crowe IV): Frequently requires a subtrochanteric shortening osteotomy, where the proximal part of the femur is resected to restore the anatomical hip center, with the stem providing rotational stability.
- Distal Fit: A tapered, conical design is generally preferred to achieve better stability in the narrow diaphysis.
- Clinical Outcomes:
- Studies show that using specialized tapered stems or modular stems in DDH patients results in high rates of osseointegration, good stability, and significant improvements in Harris Hip Scores (HHS).