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"OVERCOMING SURGICAL CHALLENGES IN OSTEOPETROSIS: FEMORAL SHAFT FRACTURE FIXATION USING A MACHINE DRILL BIT"

Orthopaedics

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ABSTRACT

Background: Osteopetrosis is a rare genetic disorder characterized by increased bone density due to defective osteoclast function, leading to brittle bones and high fracture risk. Surgical management poses challenges due to dense, sclerotic bone and instrumentation failure. **Case Presentation:** We report an 6-year-old female with osteopetrosis who sustained a femoral shaft fracture. Open reduction and internal fixation with a locking plate were performed using a machine drill bit to reduce thermal necrosis and drilling resistance. **Conclusion:** Locking plate fixation with a machine drill bit is an effective technique for osteopetrotic fractures, minimizing complications and improving surgical outcomes

KEYWORDS

Drill bits, osteopetrosis, femur fracture

INTRODUCTION

Osteopetrosis, also known as "marble bone disease," was first described by Albers-Schönberg in 1904. It encompasses a group of genetic conditions characterized by abnormally dense bones due to defective osteoclast function. Patients with osteopetrosis are at risk of fractures, delayed healing, and infections due to impaired bone remodeling. [1]

While conservative management has been suggested for femoral fractures in osteopetrotic patients, surgical intervention is often preferred due to prolonged immobilization risks. However, high bone density and obliterated medullary canals make surgical procedures technically challenging. This report discusses the successful use of a machine drill bit to address these difficulties in a pediatric osteopetrosis case. [1]

Case Report

Patient Presentation

An 6-year-old female presented with left thigh pain and an inability to bear weight after a fall. She had no prior history of fractures, No significant family history.

On examination, the patient had a triangular facial shape, and an anterior dental crossbite. Local assessment revealed mid-thigh swelling and tenderness.

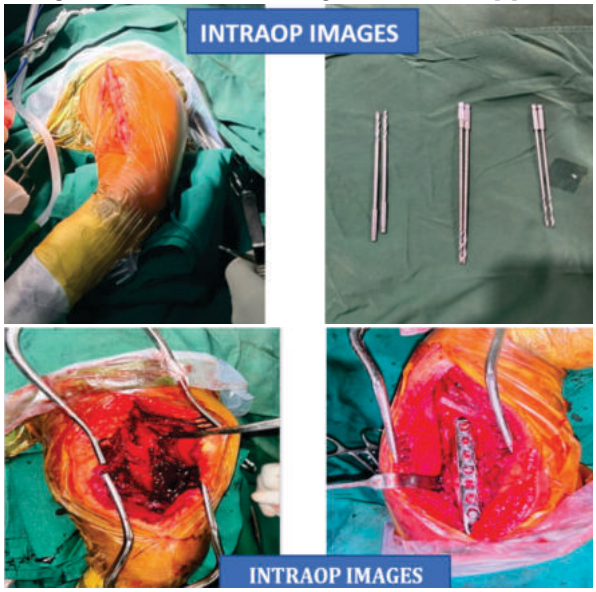
Radiographic imaging showed an transverse femoral shaft fracture with cortical thickening and reduced medullary canal diameter. A skeletal survey revealed generalized increased bone density with an obliterated medullary cavity.

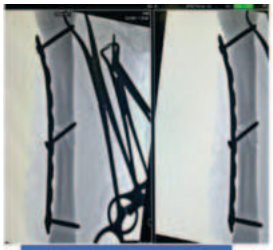
Laboratory results indicated normal hematologic parameters except for mild anemia (Hb 9.5 g/dL) and low vitamin D levels, with elevated alkaline phosphatase and creatine kinase. Based on clinical, radiological, and laboratory findings, a diagnosis of osteopetrosis was confirmed.

Surgical Technique

The patient underwent open reduction and internal fixation under general anesthesia in the lateral position. A lateral approach to the femur was used, and fracture reduction was achieved under direct vision. A reduction clamp temporarily stabilized the fracture. [2]

To overcome the high bone density, a 2.7 mm machine drill bit was initially used to create pilot holes, followed by a standard 3.2 mm drill bit. Continuous saline irrigation was applied to prevent thermal necrosis. The locking compression plate was fixed with excellent screw purchase, and no drill bit breakage was encountered. [3]





Postoperatively, radiographs confirmed proper fixation. Wound Non-weight-bearing mobilization was advised for six weeks, followed by gradual weight-bearing. At the 6weeks follow-up, the patient was healing was uneventful, and sutures were removed after two weeks. Non weight bearing with no significant complaints

DISCUSSION

Osteopetrosis is a rare genetic disorder causing brittle yet dense bones due to defective osteoclastic function. The management of femoral fractures in osteopetrosis remains debated, with conservative and surgical approaches both having drawbacks.

While intramedullary nailing is preferred for pediatric femoral fractures, it is often unfeasible in osteopetrosis due to the obliterated medullary canal. Locking compression plating provides better stability but presents challenges such as:

- Increased bone density, leading to drill bit breakage
- Thermal necrosis, caused by prolonged drilling
- Delayed healing and risk of infection, due to impaired osteoclast function
- Drilling in dense osteopetrotic bone generates excessive heat, which can lead to bone necrosis and screw loosening. Studies by Eriksson et al. and Bonfield et al [4] highlight that elevated temperatures compromise bone viability, structure, and mechanical integrity.

To address these issues, various modified drill bits have been suggested:

- High-speed steel drill bits (Imran et al.)
- Metal-cutting drill bits (Sen et al.) [5]
- Tungsten carbide drill bits (Ramiah et al.)
- In this case, a machine drill bit was used to create pilot holes before standard drilling. This method provided several advantages:
- Reduced thermal necrosis due to shorter drilling time
- Lower risk of drill bit breakage
- Cost-effectiveness compared to tungsten carbide bits
- However, machine drill bits can cause a sudden loss of resistance while drilling, increasing the risk of soft tissue injury. Fluoroscopic guidance is recommended to prevent complications.
- Due to the brittle nature of osteopetrotic bone, these patients are prone to re-fractures and implant failure. A gradual post-operative rehabilitation protocol is essential to avoid stress concentration and screw loosening. In this case, the patient remained non-weight-bearing until radiographic evidence of healing was confirmed.

CONCLUSION

Locking compression plating is a reliable method for managing femoral fractures in osteopetrotic patients. The use of a machine drill bit significantly reduces operative time and prevents complications such as thermal necrosis and drill bit failure. Careful preoperative planning, proper drilling techniques, and cautious post-operative rehabilitation are key to successful outcomes.

Key Takeaways:

Preoperative Planning: Choice of implant and drill bit is crucial.
Plating Over Nailing: Locking plates are more suitable due to obliterated medullary canals.
Drilling Techniques: Use of machine drill bits minimizes thermal damage.
Fluoroscopic Guidance: Ensures safe and precise drilling.
Gradual Rehabilitation: Prevents re-fracture and hardware failure.

This case highlights an effective approach for overcoming the unique surgical challenges posed by osteopetrosis.

Declarations

The authors declare that they have no known competing financial interest or personal relationships that could have appeared to influence the work reported in this paper.

Ethics Approval:
Not required for this case report.

Consent To Participate & Publish:
Not applicable.

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Conflict of Interest
None declared.

Data Availability: Available upon request from the corresponding author.

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