

General

Orthopaedic Trauma in Sudan: Delivering Care and Improving Outcomes in a War-Torn System

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1. INTRODUCTION

In the outskirts of Khartoum, Sudan, an elderly woman falls down a flight of stairs while escaping ongoing combat outside her window. She suffers a hip fracture but remains without a path to care- living miles away from the nearest hospital. Social media posts from family members echoed: *"Does anyone know an orthopaedic surgeon in Khartoum?"* The answers ran dry.

On the other side of town, at Bashir Teaching Hospital, one of two centers operated by Doctors Without Borders (MSF) providing acute care in the city,¹ a young boy with an open femur fracture waited over three days for initial surgical care due to a lack of orthopaedic surgeons.

These stories are not isolated cases but unfortunately a current daily reality for many in the country. Having said this, the purpose of this commentary is to:

- a) Highlight key barriers to orthopaedic trauma care in Sudan
- b) Discuss potential strategies to improve care despite ongoing conflict

2. BARRIERS TO EFFECTIVE TRAUMA CARE

2.1. INFRASTRUCTURE BREAKDOWN

It was estimated that before military conflict broke out in April 2023, approximately 80% of all healthcare services were centralized in Khartoum, Sudan's capital.² By the end of 2023, WHO reported that 70% of all healthcare facilities in the country were destroyed or forced to close.³ With few facilities operating, the remaining ones face immense challenges in delivering orthopaedic trauma care, especially in rural settings.

Between 1990 and 2019, the age-standardized incidence rate of lower-extremity fractures (LEFs) of the patella, fibula, tibia, or ankle in Sudan was 523.29 per 100,000.⁴ Since the conflict, emerging hospital-based data point towards a substantial rise in trauma-related LEFs involving the tibia and fibula. A 2023 study from Khartoum found that over 56% of extremity injuries involved the lower limb.⁵ This rise is largely due to the higher incidence of explosive trauma and crush injuries during the war period and have placed considerable stress on the few personnel managing these injuries.

2.2. SURGEON SHORTAGES & TRAINING GAPS

In the setting of an already low orthopaedic surgeon to population ratio at roughly 1.5 to 100,000 individuals,⁶ the ongoing conflict has resulted in the loss of many surgical training centers. Approximately 20 centers in Khartoum and Gezira states as well as all 3 centers in Darfur have been lost.⁷ Surgical residents have been forced to relocate to a limited number of safer hospitals, where overcrowding of trainees, limited operating room availability, and restricted surgical supplies have paradoxically led to a reduction in hands-on surgical training despite high trauma volumes. The relative decrease in educational opportunities is compounded by pre-existing gaps in training with one study citing roughly 40% of acute ankle fractures receiving documented neurovascular exams and less than 50% of operating room notes documenting procedure details, complications, and operative findings.^{8,9} Even in a hypothetical resolution of war, the well-cited "brain-drain" in developing countries is heightened in post-conflict settings and would likely further exacerbate this shortage in the future.¹⁰

2.3. RESOURCE LIMITATIONS

Facilities have faced a blockage of surgical supplies by Sudanese authorities including external fixators, traction pins, and C-arm machines.¹¹ In low-resource settings, where traction is commonly used as a mainstay management of fractures, this leaves remaining personnel with few options for management. Additionally, the lack of antibiotic prophylaxis and with 74% of hospitals in some states of Sudan not meeting WHO minimum standards for safe anesthesia, complication rates have amplified. Approximately 60% of extremity injuries due to war in the country have resulted in infection.⁵

3. OPPORTUNITIES FOR IMPROVING OUTCOMES

3.1. STRENGTHENING REGIONAL TRAUMA CENTERS

With few functional trauma centers, and a concentration of care in a couple of states, decentralization of care is a vital step towards enhancing care across the country.

In Afghanistan, improvement of regional care has led to net decreased time to care, and enhanced survival.¹² Establishing smaller regional trauma centers, even with decreased resource availability, allows for treatment of the direct orthopaedic injuries in rural areas. Partnership with NGOs and international organizations such as MSF and AO Trauma remain increasingly important for infrastructure support to carry out this task.

3.2. EXPANDING SURGICAL TRAINING

During the height of the Sudanese revolution in 2019, many health-based training efforts were targeted towards remote learning for practitioners dealing with trauma cases. In the current state of the country, remote and hybrid orthopaedic training programs that are tele-medicine based could prove beneficial to the limited staff treating injuries in the country. While tele-medicine training is most effective in the height of war, post-war education of trainees through training-based mission trips from surgeons outside the country to train surgeons in Sudan would be most effective long-term.

3.3. LOW-COST INNOVATIONS & ALTERNATIVE TREATMENT STRATEGIES

The blockage of surgical supplies in Sudan has led to a catastrophic shortage that requires alternate solutions. Given the shortage, it is important to maximize the amount of local external fixators as well as implement increased low-cost external fixator alternatives. These low-cost external fixators have been used in global surgery settings with good clinical outcomes.¹³ Having said this, enhancing funding towards organizations providing onsite care such as MSF is the most important step in distributing these devices to hospitals in the country. Additionally, mobile units with healthcare staff traveling to rural sites may be an effective strategy in decreasing time to treatment.

4. CONCLUSION

Sudan currently faces a severe orthopaedic trauma crisis due to ongoing war, limited resources, and a fragmented

healthcare system. Trauma patients face prolonged delays and high complication rates, particularly in rural and underserved regions. As a result, there must be a global call to action and assistance in investing in regional trauma care, expanding surgical partnerships, and utilizing international relationships to improve outcomes. Though there are immense challenges, viable solutions do exist. With global support and coordinated national efforts, sustainable improvements in orthopaedic trauma care can be implemented. In the face of war and instability, ensuring effective and timely surgical care is not only a medical necessity, but a moral imperative.

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GRANTS

None supplied

AUTHOR CONTRIBUTIONS

Each author made substantial contributions to the design, data acquisition, and drafting of the manuscript as described below:

Ashraf - design and planning, data gathering and interpretation, drafting of commentary

Jamal – design, data gathering and interpretation, drafting of commentary

Jose – design, drafting of commentary, proofreading, final editing

DISCLOSURES

Each author certifies that there are no funding or commercial associations (consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article related to the author or any immediate family members.

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