

# Multiple fractures after an explosive injury in Gaza

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## Abstract

**Background:** Treating cases that require different surgical specialties requires high-level interdisciplinary coordination, and prioritization of the patient's needs, which is nearly impossible in a war zone.

**Aim:** To document the case of a woman who was diagnosed with multiple fractures from an explosive injury sustained during the October 2023 war in Gaza.

**Methods:** The woman underwent 3 surgical operations, internal fixation for the rib fracture, internal fixation of the left humerus, and fixation of the mandible fracture. She was hospitalized for nearly one month in 2 admission intervals—14 days at the surgical department and 16 days at the intensive care unit.

**Result:** After prolonged interdisciplinary management, recurrent admissions and multiple operations, the patient recovered significantly well.

**Conclusion:** This case highlights the significance of a multidisciplinary approach to managing these types of injuries, and how a severe polytrauma patient can recover when provided with appropriate care in spite of the conflict.

Keywords: multiple fractures, rib fracture, mandible fracture, explosive injury, surgical operation, Gaza

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## Introduction

The Palestinian health system frequently faces significant challenges in managing medical issues because of the many war casualties presenting for treatment (1,2). The military attacks have harmed health workers and patients alike, who are often injured and treated in Gaza's hospitals (3).

Multiple injuries from aggressive trauma are frequently linked to thoracic, long bone, head, and vascular problems. Priorities include saving a life, stopping the bleeding by stabilizing the femur and pelvic fractures, saving a limb's function by treating soft tissue and vascular damage related to its fractures, preventing compartment syndrome, and preserving functionality (4). The most frequent injury after thoracic trauma is traumatic rib fracture causing pneumothorax or haemothorax, which are definitively managed with tube thoracostomy (6). The patients often need to be admitted in an intensive care unit (ICU), while 25% of them need invasive mechanical ventilator assistance (5). All of these injury characteristics were present in one case after an explosive injury during the October 2023 war in Gaza, which is described in this paper.

## Case description

AR presented to the emergency room at Ahli Arab Hospital in a mass casualty as a result of an explosive injury. Her condition was critical with severe hypotension

and polytrauma. She had multiple fractures and was hemodynamically unstable. Her blood pressure was 86/55 mmHg, heart rate 129 bpm and oxygen saturation (O<sub>2</sub> SATs) 84% in room air. After resuscitation, her vitals gradually stabilized with a 112/70 mmHg blood pressure, 102 bpm heart rate and O<sub>2</sub> SATs 97% on 10 litres by simple mask. Shortly after stabilization, she had to be evacuated and transferred to Indonesia Hospital. She underwent 3 operations and was hospitalized for nearly one month in 2 admission intervals (14 days at the surgical department and 16 days at the ICU department).

Upon admission, the patient received full evaluation by the emergency doctor, her blood pressure was 105/60 mmHg, O<sub>2</sub> SATs was 94% on 5 litres via simple mask, heart rate 105 bpm, and temperature 38.3°C. The doctor requested X-ray images, CT scan and laboratory tests (complete blood count CBC, ABO typing) to assess the extent of the patient's injuries. She was diagnosed with multiple right anterior ribs fractures (2nd, 3rd, 4th, and 5th), D12 anterior burst fracture, left closed shaft humerus fracture, and mandible fracture. She suffered from haemothorax, which caused a marked drop in her haemoglobin levels and packed cell volume (PCV) value. Her blood group typing was O-negative. She was under close observation. She received nearly 8 units of packed red blood cells (RBCs) with regular CBC follow-up to correct the acute bleeding. She was observed and followed up by various available specialized doctors.

## Hospitalization and operations

### First operation

#### Preoperative diagnosis

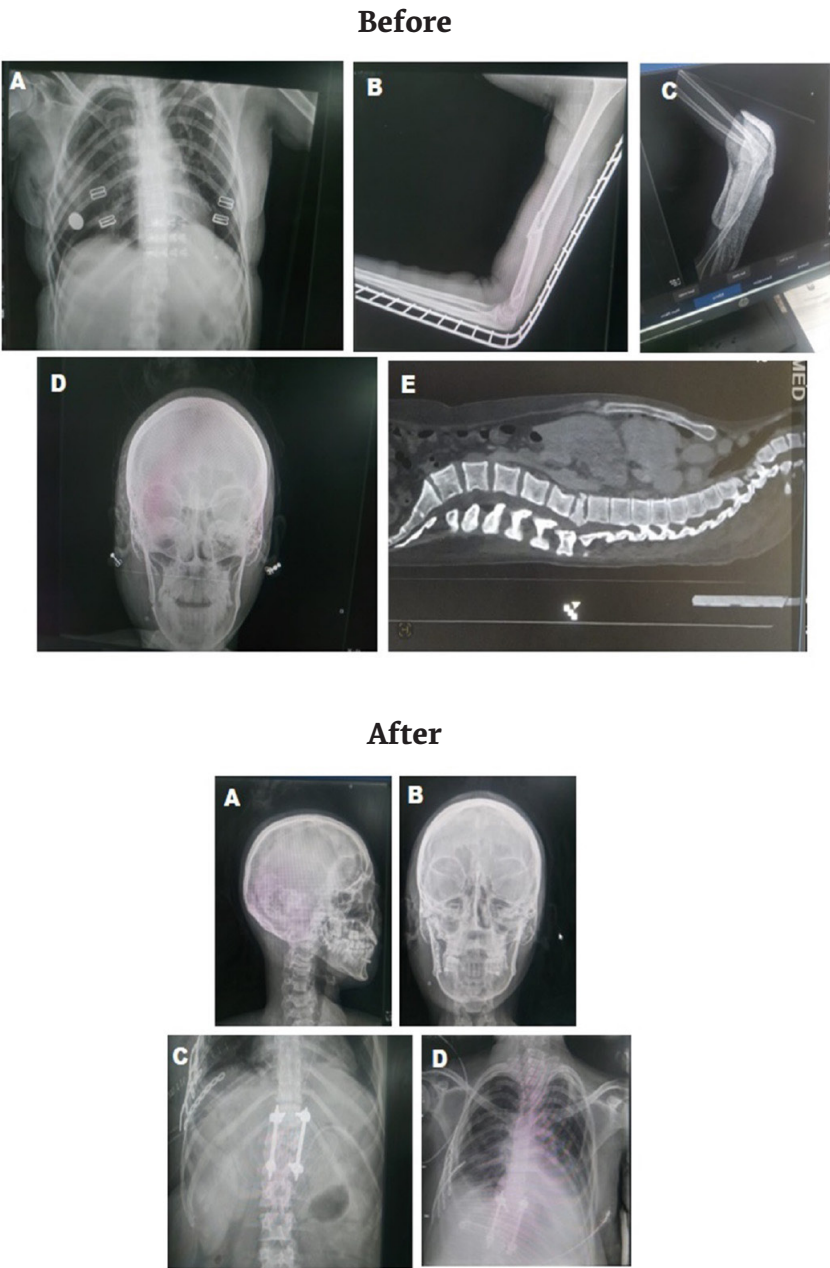
She entered the operation theatre as an emergency case with stable vitals, a combined operation that included neurosurgery, thoracic and maxillofacial surgery, which lasted 9 hours on 7 July 2024.

#### Operation

The doctors first attended to the rib fracture fixation because of the life-threatening complications, mainly respiratory distress, hypoxia and severe pain. The patient underwent internal fixation for the posterolateral

rib fractures from the second to the fifth rib using reconstructive plates of 3.5 mm for each rib, which varied in length according to the number of fractures in each rib. The mandible fracture represented a real obstacle because the patient had multiple fractures and was required to have a rich diet in order to promote the healing process. Therefore, it was important to deal with this injury to prevent infections and allow for oral intake. The mandible fractures were managed using combined methods that used lag screws and upper border plates, as shown in the X-rays (Figure 1). Spinal fixation was performed to prevent further complications and allow for early rehabilitation and physiotherapy. Considering the lateral positioning of the patient during the rib fixation procedure, it was manageable to transform to

Figure 1. Patient's x-ray before and after the first operation



the prone position for the spinal fixation procedure. The D12 fractures were fixed using bilateral pedicle screws and rods between D11 and L1. It was a crucial decision to perform all the necessary and available surgeries because they may be impossible later for unexpected periods and reasons.

**Post-operative care**

She had a relatively stable hemodynamic status; her blood pressure was 100/58 mmHg, O<sub>2</sub> SATs 91% on 3 litres oxygen via nasal cannula, heart rate 112 bpm, temperature 37.5°C. The patient received daily dressing with a sterile technique at the ward under sedation (using a combination of ketamine and midazolam-dormicomp), in addition to post-operative antibiotics Ceftriaxone 2 g daily and flagyl 500 mg 3 times daily.

**Second operation**

**Preoperative diagnosis**

As a result of empyema collection at the previous site of haemothorax, which is definitely managed with tube thoracostomy (6), this procedure was done under general anaesthesia due to traumatic rib fracture and suspected

complications. She had a marked drop in her O<sub>2</sub> SATs, high-grade fever and dyspnoea; her blood pressure was 110/70 mmHg, O<sub>2</sub> SATs 81% on room air, heart rate 109 bpm, and temperature 39.5°C.

**Operation**

A low chest tube insertion under general anaesthesia was done to evacuate the chest empyema. There was no thoracic surgeon available, therefore, a conservative approach was taken to prevent complications of sepsis, septic shock and dyspnoea. Ideally such conditions would warrant a decortication, which is an invasive operation that requires postoperative ICU management.

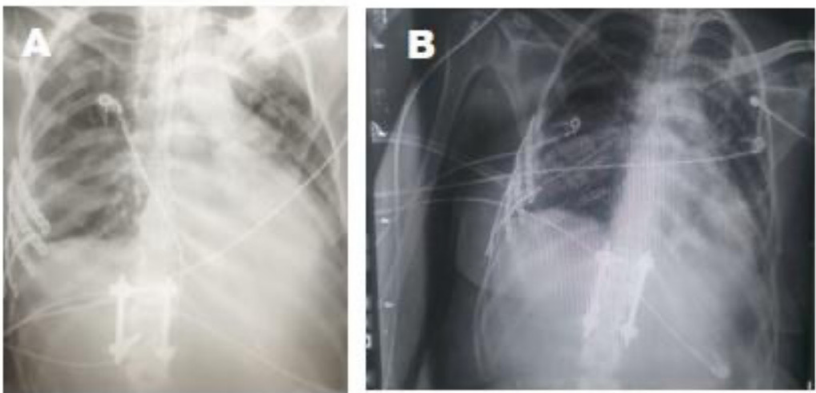
**Post-operative care**

After operation her O<sub>2</sub> SATs was 92% on room air and then 98% on 5 litres oxygen via simple mask (Figure 2).

**Admission to intensive care unit**

The patient was transferred to ICU at Indonesia Hospital on 30 July 2024 due to infected wounds and sepsis. The doctor requested many cultures (tip of the central line, sputum, blood, urine from the catheter, and pleural

**Figure 2. Patient's x-ray before and after the second operation**



**Table 1. Timeline of patient management**

Date	Action
7 July 2024	Presented to the emergency department at Al Ahli Arab Hospital
7 July 2024	Transferred to operating room at Indonesia Hospital
7 July 2024	Performed a combined operation that included neurosurgery, thoracic and maxillofacial surgery
21 July 2024	Discharged from the surgical department at Indonesia Hospital
30 July 2024	Readmitted to surgical department at Ahli Arab Hospital
30 July 2024	Transferred to the ICU department at Indonesia Hospital
15 Aug 2024	Discharged from ICU department at Indonesia Hospital
24 Sep 2024	Referred to surgical department at Al Ahli Hospital
25 Sep 2024	Discharged from surgical department at Al Ahli Arab Hospital

effusion). Her blood pressure was 96/60 mmHg, O<sub>2</sub> SATs 89% on room air, heart rate 115 bpm, temperature 39.3°C.

The central line tip and pleural effusion were immersed in thioglycolate broth media for approximately 16–24 hours. The blood culture was then placed in both aerobic (tryptic soy broth) and anaerobic media (thioglycolate broth) containing sodium polyanethol sulphate (SPS) as an anticoagulant and inhibitor for natural immunity. They were then allowed to incubate at 37° C overnight. Urine and sputum were directly inoculated onto blood agar and MacConkey agar. All were then incubated at 37°C overnight. The following day, turbidity via broth media and gross colony on petri dishes were observed in all of the incubated media. After being diagnosed using analytical profile index (API) 20E procedures, they were sub-cultured on Muller-Hinton agar for sensitivity testing using appropriate antibiotics according to the Clinical and Laboratory Standards Institute (CLSI) guidelines. Then, tubes that expressed positive results via broth media were inoculated on MacConkey agar and blood agar (additional culture of blood sample on chocolate agar media) and incubated at 37°C overnight. The same testing procedure for antibiotic sensitivity was repeated for other samples.

*Klebsiella* was the main pathogen. The presence of *Pseudomonas* in the urine may be due to the nosocomial infection, as she was hospitalized for a long time and *Chromobacterium violaceum* in the pleural fluid may be due to environmental contamination with water and soil, which may have caused serious complications such as sepsis and septic shock. Some 6 g of amikacin was administered as a loading dose, followed by 2 g/24 hr for 3 days. After that, she was switched to a combined antibiotic therapy (meropenem for 10 days and colistin for 14 days).

## Third operation

### Operation

Internal fixation of her left shaft humerus fracture was performed. A 7-hole dynamic compression plate was inserted and fixed by 6 screws.

### Post-operative care

The patient was discharged after 3 days with clean wound and stable fixation to return for follow-up after 2 weeks. Upon discharge she was vitally stable, afebrile and her blood pressure was 115/80, O<sub>2</sub> SAT was 96% on room air and heart rate was 92 bpm.

After a prolonged interdisciplinary management, recurrent admissions and multiple operations, the patient recovered significantly well given the severe and complicated nature of her injuries. The patient resumed oral intake with full jaw function after 6 weeks of the mandible fixation. Her pulmonary function was restored and her chest empyema was treated successfully without any disability. She started walking short distances with assistance after only 4 weeks post-operation. She now has a full range of motion for her left shoulder and 80% power of the whole limb, and continues to receive physiotherapy.

## Conclusion

Management of the humerus fracture was delayed due to several factors. She required multiple interventions, there was a flow of patients with more serious injuries, and several evacuations due to the circumstances of the war. Such interruptions played a major role in delaying many similar medical interventions. This case provides insights to the significance of a multidisciplinary approach to managing these types of injuries and shows that a severe polytrauma patient can recover if provided appropriate care despite the circumstances of war.

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**Conflict of interest:** None declared.

## Fractures multiples après une blessure par explosion à Gaza

### Résumé

**Contexte :** La prise en charge des cas nécessitant différentes spécialités chirurgicales exige une coordination interdisciplinaire de haut niveau et une priorisation des besoins des patients, conditions presque impossibles à réunir dans une zone de guerre.

**Objectif :** Documenter le cas d'une femme ayant été diagnostiquée avec des fractures multiples à la suite d'une blessure par explosion survenue pendant la guerre à Gaza en octobre 2023.

**Méthodes :** La patiente a subi trois opérations chirurgicales : une fixation interne pour une fracture costale, une fixation interne de l'humérus gauche et une fixation d'une fracture de la mandibule. Elle a été hospitalisée pendant près d'un mois, réparti sur deux périodes : 14 jours au service de chirurgie et 16 jours en unité de soins intensifs.

**Résultat :** Après une prise en charge interdisciplinaire prolongée, plusieurs hospitalisations et de nombreuses interventions chirurgicales, la patiente a présenté une récupération significative.

**Conclusion :** Ce cas met en évidence l'importance d'adopter une approche multidisciplinaire dans la prise en charge de ce type de blessure, et montre qu'un patient atteint de polytraumatisme grave peut se rétablir lorsqu'il bénéficie de soins appropriés malgré le contexte de conflit.

## الكسور المتعددة بعد إصابة ناجمة عن انفجار

حسن حمدان، سماح الشامي

### الخلاصة

الخلفية: إن علاج الحالات التي تتطلب تخصصات جراحية مختلفة يتطلب تنسيقًا متعدد التخصصات رفيع المستوى، وتحديدًا دقيقًا لأولويات احتياجات المريض، وهذا أمر شبه مستحيل في مناطق الحروب.

الأهداف: هدفت هذه الدراسة إلى توثيق حالة امرأة شُخصت بإصابتها بكسور متعددة ناجمة عن إصابة انفجارية لحقت بها خلال حرب أكتوبر/ تشرين الأول 2023 في غزة.

طرق البحث: خضعت المرأة إلى ثلاث عمليات جراحية، وتثبيت داخلي لكسر في الأضلاع، وتثبيت داخلي للعضد الأيسر، وتثبيت لكسر في الفك السفلي. وأدخلت المستشفى لمدة شهر تقريبًا على فترتين فاصلتين؛ إذ أمضت 14 يومًا في قسم الجراحة و16 يومًا في وحدة العناية المركزة.

النتيجة: بعد مدة طويلة من العلاج المتعدد التخصصات، والإدخال المتكرر إلى المستشفى وعدة عمليات، تعافت المريضة بشكل جيد للغاية.

الاستنتاجات: تبرز هذه الحالة أهمية اتباع نهج متعدد التخصصات في العلاج لهذا النوع من الإصابات، وإمكانية تعافي المصابين برضوخ متعددة وخيمة في حالة توفير الرعاية المناسبة لهم رغم ظروف النزاع.

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