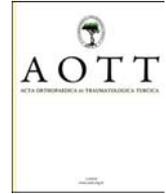


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## Where is the fracture? Penetrating injury with a foreign bone

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## ABSTRACT

Injuries in the explosion scenarios are usually hollow organ injuries including rapid gas expansion, thermal injuries, penetrating injuries due to secondary projectiles and secondary injuries like falls and burns. Our case is a penetrating injury that was considered open knee fracture (Gustilo Anderson Type 3A) and peroneal nerve palsy in the emergency service after bomb attack but later it was seen that the secondary projectile was a foreign bone and the patient's bone integrity was intact. Our aim is to show that specific human tissues must be considered as a factor in the secondary injuries.

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## Case report

A 34-year-old male patient was brought to our emergency room after a bomb attack. In the first examination of the conscious patient, there were burns and incisions in various parts of his body. An injury of approximately 10 cm in length was detected in the lateral side of the left knee, where the bone tips were exposed (Fig. 1).

Physical examination of the left lower extremity revealed that the pulse was palpable distal to the injury. The patient was found to have peroneal nerve sensory hypoesthesia without ankle and finger dorsiflexion. Follow-up and treatment with Gustilo-Anderson Type 3A open fracture was started. Antibiotic prophylaxis and tetanus prophylaxis were performed in the emergency department. 120 mg of gentamycin and 1 g of cefazolin were started as in all open fractures. Because of concern regarding infection with blood-borne pathogens, the patient were tested for hepatitis B virus, hepatitis C virus and human immunodeficiency virus serology. No hepatitis B vaccination was performed since it was found to be immune to hepatitis B virus according to the serology results. The patient's direct X-rays showed that bone integrity was preserved and the bone fragment that was exposing the wound did not belong

to the patient (Fig. 2). After the examination of the relevant sections, the spleen injury and lung contusion were also detected. The patient was quickly transferred to the operating room and splenectomy was performed by general surgery. Subsequently, the foreign bone fragment was removed from the cut on the left knee and the wound debridement was performed (Fig. 3). Since the wound site was not in close relation with the peroneal nerve, exploration was not performed additionally. The patient who was initially treated as an open fracture and started antibiotherapy was consulted to the clinical infectious diseases after being understood that there was no open fracture. It has been suggested that the patient with adequate surgical debridement and irrigation should be given antibiotics to be discontinued at 72 h postoperatively. Policlinic control was recommended for follow-up of viral serology. The patient was followed up at the post-operative intensive care unit and was discharged after no problems developed. He was followed up for wound condition and neurological palsy. Follow-up ENMG was found to be consistent with axonal injury at the fibular head level of the peroneal nerve. Neurological palsy returned in 3 month follow-up.

## Discussion

In the recent period with the increase of terrorist attacks against civilians, explosion injuries can be seen in a wide range of all over the world. Especially as a result of bombed terrorist attacks, widespread injuries and deaths occur. The resulting explosion injuries were divided into 4 types as primary, secondary, tertiary and

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Fig. 1. Injury around the left knee.

quaternary<sup>1,2</sup> (Table 1). This classification is based on the mechanism rather than the seriousness of the injury. Primary explosion injuries are caused by barotrauma that is formed by the initial pressure wave. The most serious injuries to the musculoskeletal system after the explosion are due to primary injury, and more than one type of injury is frequently observed.

As a result of the resulting bursts, bone fractures and fragmentations in the limbs can be observed.<sup>3,4</sup> Secondary explosion injuries occur with the explosive energy and the flying objects that have become bullets. These secondary bullets, which are an important factor in post-explosion injuries, can be any object in the

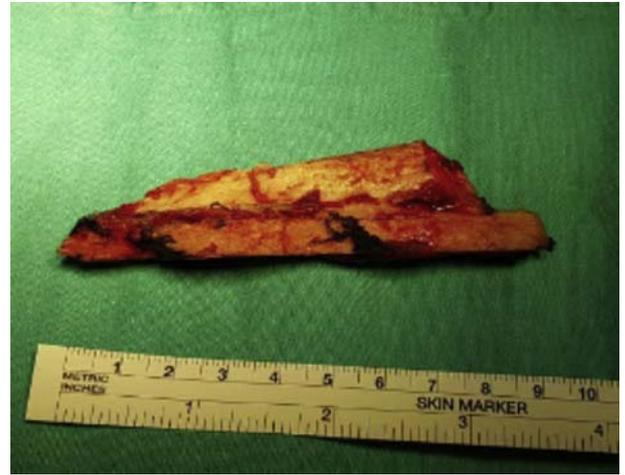


Fig. 3. Foreign bone tissue.

environment. Foreign bodies that quickly penetrate the body after an explosion can cause extensive tissue damage in the abdominal region, thorax, and cranial region, particularly in fragile tissues. Tertiary explosion injuries occur when the shock wave generated after the explosion displaces the victim's body. Usually people are hurt by striking fixed objects such as walls or floors. Quaternary explosion injuries are thermal and inhalation injuries that occur with heat and gases after explosion. As they move farther away from the source point, their impact on the environment decreases exponentially. All soft tissue and bone injuries can occur with one of the four explosion mechanisms, but secondary injuries are believed to be more common than the primary ones.<sup>5</sup>

Bone tissue that expands from the wound by deteriorating tissue integrity usually appears as an impaired bone integrity of the individual and is considered an open fracture. However, penetrant injuries due to allogenic bone fragments that can interfere with



Fig. 2. Pre-operative and post-operative radiographs.

**Table 1**  
Early effects of blast and bursts.<sup>2</sup>

Type of explosion injury	Mechanism	Injury
Primary	Explosion wave	Tympanic membrane rupture Pulmonary injury or air embolism
Secondary	Bullets hit the victim	Penetrating ballistic trauma Blunt ballistic trauma
Tertiary	Wind that displaced the victim's body	Penetrating trauma Blunt trauma
Quaternary	Secondary to fire, hot gasses and carbonmonoxide	Burns or asphyxia Exposure to toxic agents

open fractures are rarely found in the literature.<sup>6,7</sup> Unlike our case, penetrating bone tissue in previously reported cases did not cause any neurological or vascular lesions in patients.

Management of explosion-induced skeletal injuries includes direct radiograph to evaluate fractures and foreign bodies, tetanus prophylaxis, and broad-spectrum antibiotic therapy if open fractures are present.<sup>8</sup> Debridement and wound excision should be performed as early as possible. Early prophylaxis and debridement considerably reduce infection rates.<sup>9,10</sup>

With the increase of terrorist attacks, more than one types of explosion injuries are seen. In terrorist civilian bombs, penetrating injuries are more common than military explosions due to the lack of body shields.<sup>5</sup> Therefore, penetrant injuries caused by secondary bullets due to explosive properties are more common in civilian

terrorist attacks. After the explosion, any object in the environment can turn into bullets. As with this case, it should be kept in mind that human tissues which are disintegrated after explosion may also be a secondary projectile. Differential diagnosis should be made correctly with the help of good post-physical imaging methods and the risk of infection should be minimized by applying correct treatment protocol at the next stage.

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