Orthopaedics & Traumatology: Surgery & Research (2013) 99, 953—958

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

ORIGINAL ARTICLE

Management of civilian ballistic fractures

V.S. Seng*, A.C. Masquelet

Service de chirurgie orthopédique et traumatologique, hôpital Avicenne, 93000 Bobigny, France

Accepted: 27 August 2013

KEYWORDS
Ballistic fracture;
Gunshot wound;
Civilian;
Debridement;
Infection

Summary
Introduction: The management of ballistic fractures, which are open fractures, has often been studied in wartime and has benefited from the principles of military surgery with debridement and lavage, and the use of external fixation for bone stabilization.
Hypothesis: In civilian practice, bone stabilization of these fractures is different and is not performed by external fixation.
Patients and methods: Fifteen civilian ballistic fractures, Gustilo II or IIIa, two associated with nerve damage and none with vascular damage, were reviewed. After debridement and lavage, ten internal fixations and five conservative treatments were used.
Results: No superficial or deep surgical site infection was noted. Fourteen of the 15 fractures (93%) healed without reoperation. Eleven of the 15 patients (73%) regained normal function.
Discussion: Ballistic fractures have a bad reputation due to their many complications, including infections. In civilian practice, the use of internal fixation is not responsible for excessive morbidity, provided debridement and lavage are performed. Civilian ballistic fractures, when they are caused by low-velocity firearms, differ from military ballistic fractures. Although the principle of surgical debridement and lavage remains the same, bone stabilization is different and is similar to conventional open fractures.
Level of evidence: Level IV (retrospective study).

Introduction

Surgeons may encounter gunshot wounds, even outside of military conflicts. In wartime [1,2] and in peacetime [3], gunshot wounds mainly affect the limbs, predominantly the lower limbs.

The lesional spectrum of gunshot wounds of the limbs is wide, ranging from the simple injury to soft tissues to bone injury (ballistic fracture, which is by definition an open fracture), to crushed bone with devascularization of the limb and nerve injury.

These ballistic fractures of the limbs have been mainly studied in armed conflicts in military hospitals. Their management in the civilian setting has long been based on military practices, notably with debridement and lavage, as well as bone stabilization using external fixation.

The objective of this study was to assess the results of surgical management of civilian ballistic fractures that did

* Corresponding author. Tel.: +33 6 84 11 52 31.
E-mail address: sebastien.seng@gmail.com (V.S. Seng).

1877-0568/$ - see front matter © 2013 Elsevier Masson SAS. All rights reserved.
http://dx.doi.org/10.1016/j.otsr.2013.08.005

not make use of external fixation. We hypothesize that in civilian settings, the bone stabilization method of these ballistic fractures differs from that used in the military context.

Patients and methods

Between 2008 and 2012, 15 patients (13 males and two females; mean age, 28.5 years, range, 19—55 years), victims of firearm injures with limb bone involvement (excluding the spine), were surgically managed. All ballistic fractures were caused by 9 mm bullets. In three cases, bone injury was associated with visceral injury, which was always operated first.

Upper limb bone involvement was found in four cases (Fig. 1), and lower limb in 11 cases (Table 1).

Six fractures were comminuted. All fractures were II or IIIa on the Gustilo classification (preoperative confirmation) [4]. Two fractures (13%) were associated with nerve injury (Table 1). In each case, the nerve was continuous on surgical exploration. No fracture was associated with vascular injury.

All the fractures were managed medically in less than 1 h and were operated in the operating room within a mean of 9.7 h after injury (range, 3.5—24 h). Antibiotic therapy was initiated. The choice of antibiotics varied depending on the operators: either amoxicillin + clavulanic acid was administered for at least 48 h or amoxicillin + clavulanic acid + gentamicin for at least 48 h (Table 1).

Surgical technique

Under general anaesthesia, debridement of the entry and exit points as well as lavage of the bullet trajectory in the soft tissue to the bone were performed. Small devascularized fragments were excised; pediculated bone fragments and those with muscle attachment were preserved. A fasciotomy of the muscle compartments was performed systematically. The surgical site was then washed with saline to be sure that no foreign body (notably from clothing) remained in the surgical site.

Depending on the type and stability of the fracture, bone stabilization was or was not provided with internal fixation: in ten cases out of the 15 (67%), internal fixation was used (Table 1) (Figs. 2—4); in five cases (33%), conservative treatment was selected. Primary closing with a drain was carried out.

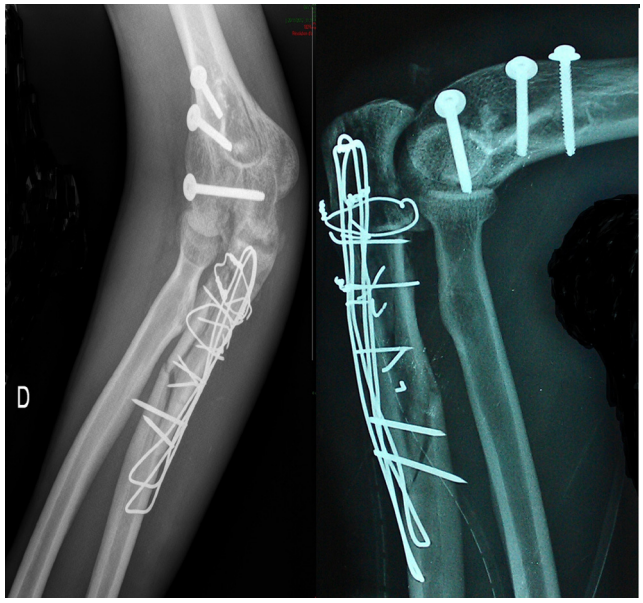

Figure 2 Internal fixation of the fracture in Fig. 1.

Figure 1 Entrance (a) and exit point (b), X-rays (c), and 3D CT (d) of a comminute ballistic fracture of the proximal ulna and lateral condyle of the distal humerus.