Orthopaedics & Traumatology: Surgery & Research xxx (2016) xxx–xxx

Available online at
ScienceDirect
www.sciencedirect.com

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

Technical note

Anterior pre-tensioned external fixator for pelvic fractures and dislocations. Initial clinical series

A. Queipo-de-Llano, M. Lombardo-Torre*, A. Leiva-Gea, F.B. Delgado-Rufino, F. Luna-González

Servicio de Cirugía Ortopédica y Traumatología (4th Floor), Hospital Universitario Virgen de la Victoria, Campus Teatinos s/n, 29010 Málaga, Spain

ARTICLE INFO

Article history:
Received 9 May 2016
Accepted 5 September 2016

Keywords:
Pelvis fracture
Urgent stabilization
Pelvic compression
External fixation
Pre-tensed bar

ABSTRACT

In the treatment of unstable pelvic ring fractures, external fixators have the limitation of not adequately stabilizing the injured posterior elements. This article presents a novel and simple technique of temporary external fixation of the pelvic ring, able to produce compression of both the anterior and posterior pelvic elements. A curved flexible carbon-fiber rod is used, pre-tensioned before attachment to supra-acetabular Schanz screws. Although more extensive clinical experience is required, favorable preliminary results in a series of 13 patients with unstable pelvic fracture were encouraging: the aim of closing the posterior and anterior elements of the pelvic ring was achieved in all cases treated with this technique, and 12 patients survived. Radiological results were excellent in 3 cases and good in 9 cases. No major complications, such as secondary displacement, vertical re-displacement or deep infection, were observed. Mean operative time was 25 min, compatible with emergency management.

1. Introduction

Anterior external fixation continues to play a fundamental role in the mechanical stabilization of pelvic ring lesions and in the control of hemorrhage. It also facilitates pain control, safe transfer of polytrauma patients and the conduct of complementary examinations [1–7]. However, the standard anterior external fixation configurations described hitherto have the disadvantage of being unable to generate posterior compression forces, and thus are not effective in stabilizing pelvic injuries involving unstable posterior elements [8,9].

For decades, orthopedic surgeons have tried to design anterior external fixation configurations capable of producing compression of the posterior pelvic elements [10–15], with good results in biomechanical studies; but they are complex and cumbersome, which seriously limits their use in emergency settings.

In a recent biomechanical study using a synthetic pelvis, Queipo-de-Llano et al. [16] described a new anterior external fixator technique based on Gänsslen's model [17], modified by pre-tensioning a curved carbon-fiber rod. The technique is based on the elasticity of a curved carbon-fiber rod that, once pre-tensioned using a specially designed tensor, is fixed to supra-acetabular Schanz screws. In manually reduced pelvic models, releasing the tensor caused the rod to tend to return to its original form, producing compression of both anterior and posterior pelvic elements (Fig. 1). The aim of the present report is to describe the surgical technique and initial clinical and radiological results obtained in 13 patients with the application of this modified anterior external fixator in the treatment of unstable pelvic ring injuries.

2. Materials and methods

In the period 2013–2015, the authors used the curved pre-tensioned external fixator as an emergency provisional treatment in 13 patients with unstable pelvic fracture. Eleven were males and 2 females. The average age was 44.3 years (range, 25–66 years). Pelvic lesions were classified following the AO/OTA, Young and Burgess and Isler et al. classifications [18] (Table 1). The injury mechanism was, in 6 cases, a fall from more than 3 m and, in 7 cases, a vehicle accident (5 traffic accidents and 2 vehicle run-overs at work, 1 by a tractor and another by a forklift truck). The average *Injury Severity Score* (*ISS*) was 36.4 (range, 18–66): among associated lesions, 6 patients presented spinal fracture and only 1 presented a femur fracture. Hemodynamic status before external fixation and the initial treatment is described in Table 1. In 6 cases, other pelvic stabilization strategies were implemented before the

* Corresponding author.
E-mail addresses: aqueipot@gmail.com (A. Queipo-de-Llano), lombardotorre.m@gmail.com (M. Lombardo-Torre), antonioleiva7@yahoo.es (A. Leiva-Gea), borjadelgado@telefonica.net (F.B. Delgado-Rufino), flunagon@gmail.com (F. Luna-González).

http://dx.doi.org/10.1016/j.otsr.2016.09.013
1877-0568/

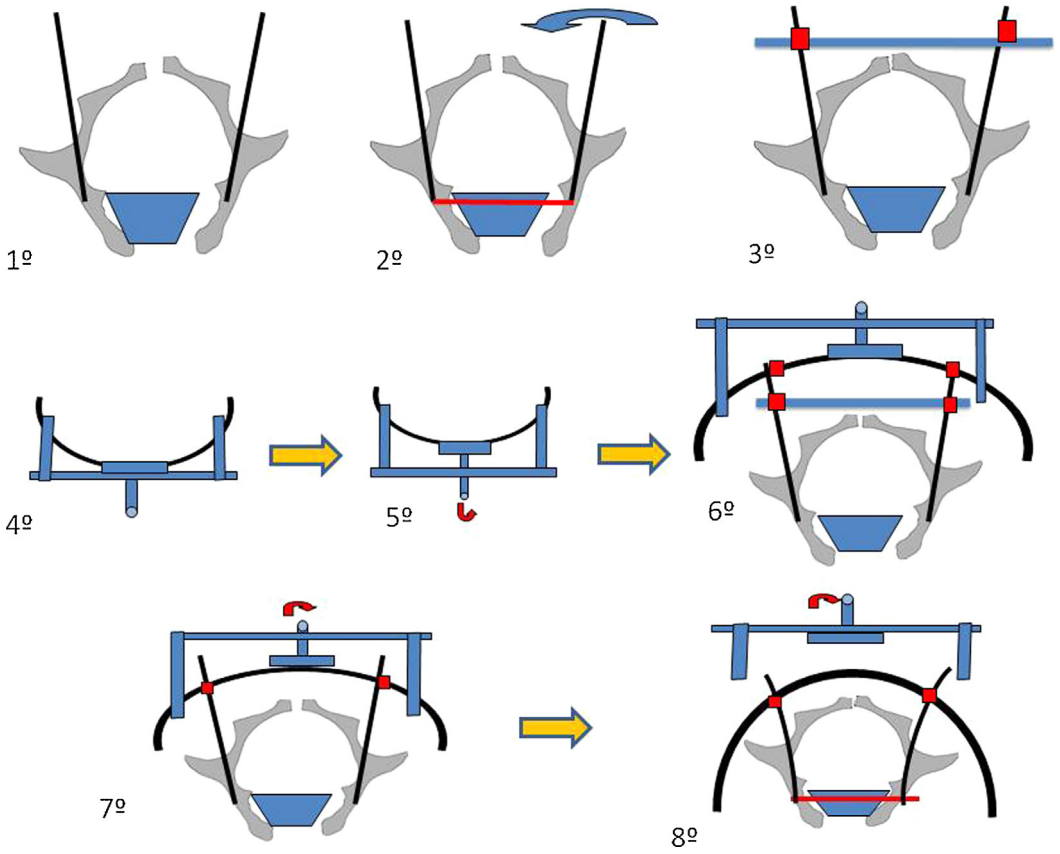

Fig. 1. Principle of action of the pre-tensed pelvic external fixator and sequence of reduction: if desired provisional fixation of reduction with a straight rod (1° to 3°), tense and placement of the pre-tensed curved rod using the tensor and fixation to the Schanz screws (4° to 6°), removal of the provisional rod (7°). Releasing the tension of the rod will cause that the rod try to recover its original shape producing anterior and posterior pelvic compression (8°).

external fixator was applied. The majority of these patients were partially hemodynamically stabilized after ATLS (Advanced Trauma Life Support) resuscitation measures and all were admitted to the ICU after the surgical treatment.

2.1. Surgical technique

All pelvic injuries were stabilized by the authors using the following surgical technique. Under C-arm radiological control and via a mini-approach, one 5–6 × 250 mm stainless steel Schanz screw was inserted into each ilium in supra-acetabular position. In injuries with anterior hemipelvic displacement, preliminary reduction and closure of the anterior ring and temporary fixation were carried out using 2 pin-to-tube clamps and an 11 mm straight bar placed as close as possible to the skin. In mainly a horizontal outward displacement (cases 4, 5, and 7), an internal rotation force was applied via the Schanz screws to reduce the anterior ring. In one case (case 8) with medial hemipelvic displacement due to lateral compression, external rotation reduction was performed. In cases with instability and vertical displacement (cases 2, 6, 9, 10, 12 and 13), traction was applied of the ipsilateral lower extremity and along the axis of the Schanz screw to correct the posterior displacement at the same time as the closure of the anterior ring (Fig. 1). At this stage, the inlet radiological view is important, to avoid producing symphyseal overlap (Fig. 2). Once the anterior part of the pelvic ring was closed, a curved carbon fiber rod, 11 mm thick with an angle of 155° (Synthes, Oberdorf, Switzerland), was selected. Using a tensor device, specially designed by the first author, the rod was pre-tensioned to a distance of 55 mm at the central application point.

This curved rod, pre-tensioned and held by the tensor, was fixed to both Schanz screws with 2 adjustable clamps (AO tubular system clamps in 4 cases, and Hoffman III Stryker-Medical external fixator clamps in the others), so that the rod was in the same plane as the Schanz screws, as close as possible to the other fixator bar. The provisional straight rod and its respective clamps were removed and the surgeon proceeded to slacken off the tensor device. At this stage, the tensor was removed (Fig. 1). Finally, correct sacroiliac joint reduction was checked radiologically (Fig. 2). If any unwanted deformity or undercorrection was seen after releasing tension in the curved bar, bar tension could be further released and a new reduction maneuver applied. Finally, once the external fixator was assembled, the skin in contact with the Schanz screws was released as necessary, ensuring that no skin tension persisted. Sutures were then performed and the Schanz screws were dressed with Surgicel® to avoid post-operative bleeding. The immediate postoperative regimen depended on the patient's status and was identical to that for other external fixators. An example of results (case 10) can be seen in Figs. 3 and 4.

3. Results

Mean operative time was 25.4 min (range, 20–45 min). Twelve patients had a favorable progression One patient died, having sustained a "crush syndrome" after being run over by a tractor: he died 48 h after admission, with a hemoglobin level of 8 g/dl; lactic acid level was 7 mmol/l on arrival in the emergency room and 24 mmol/l at death. In no cases was pelvic packing required; this decision was confirmed by the duty general surgeon and the anesthesiologist, as the hospital protocol required.

Please cite this article in press as: Queipo-de-Llano A, et al. Anterior pre-tensioned external fixator for pelvic fractures and dislocations. Initial clinical series. Orthop Traumatol Surg Res (2016), http://dx.doi.org/10.1016/j.otsr.2016.09.013