



## Indications and limitations of the fixator TGF “Gex-Fix” in proximal end humeral fractures



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### ABSTRACT

The incidence of fractures of the humerus has increased exponentially in recent years. The most used classifications for humerus fracture are morphological (Neer), biological (AO/ASIF) and descriptive (Hertel). The types of surgical treatment for humerus fracture include prosthetic replacement and synthesis using different devices, including the Tension Guide Fixator (TGF), Gex-Fix. External fixation for displaced proximal humeral fractures avoids dissection and soft tissue stripping and has been reported by some authors to be associated with higher union rates, a lower incidence of avascular necrosis, less scarring of the scapulohumeral interface, and faster rehabilitation compared with open reduction and internal fixation. Other authors have reported that external fixation does not ensure acceptable reduction and fracture stability, particularly in patients with osteoporosis.

The external fixation technique involves the introduction of Steinmann's pin to keep manual reduction, the introduction of two K-wires in the humeral head, the removal of the Steinmann's pin, and the introduction of two fiches on the humeral shaft. Hub connectors are mounted on the wires and on the chips to connect the outer bar and tensioning system.

A total of 84 patients aged 42–84 years with proximal end humeral fractures (66% had two-part fractures) were treated with Fixator TGF in this study from December 2007 to June 2012. The postoperative recovery was earlier and the active-assisted motion was less painful than has been reported with other surgical techniques. The TGF was removed without anaesthesia at the outpatient clinic at a mean of 7 weeks (range 5–8 weeks) after surgery, and there was no loss of reduction or secondary displacement after removal. These results, after five years of experience, confirm that the best indication for this fixator is two- or three-part fractures because the device enables early active mobilisation. The limitations of this fixator are evident in fractures in which closed reduction is not possible and in three-part fractures with varus displacement because the TGF has less stability than other systems, such as the plate or cage. The short learning curve, reduced surgical time and risk, and low cost encourage the use of this technique.

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### Introduction

Fractures of the proximal humerus account for 4% of all fractures and are the third most common fracture in the elderly after fractures of the neck of the femur and fractures of the wrist [1,2]. The female-to-male ratio of these fractures is 2:1. The incidence increases with advancing age equally in both sexes. The choice of treatment is closely related to the type of fracture and the remaining vascularisation of the humeral head.

The fractures of the surgical neck of the humerus are the most common of the proximal humerus fractures, and are observed

mainly in elderly patients with osteoporotic bone [3]. These are extracapsular fractures and are less likely to develop avascular necrosis compared with fractures of the anatomical neck. The proximal fragment is usually abducted and externally rotated because the muscles are inserted on the greater tuberosity of the humerus, while the distal fragment is adducted and internally rotated by rotator muscles.

The symptomatology is characterised by pain, defensive attitude of the limb deformity, soft tissue swelling and Hennequin ecchymosis of the arm (in the inner part of the arm).

The most used classifications for humerus fractures are: morphological – type and number of fragments (Neer); biological – residual vascularisation (AO/ASIF); and descriptive – Lego System (Hertel). The classification by Neer [4] and that by Hertel et al. [5] are widely used. The classification by Hertel is a descriptive system

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called the “Lego system” because of the subdivision of the proximal humerus into four “building blocks”: head, shaft, and small and great tuberosity. Hertel identifies five levels of separation of bone components: great tuberosity/head; great tuberosity/diaphysis; small tuberosity/head; small tuberosity/diaphysis; and small/great tuberosity. These five levels produce twelve different fracture patterns: six two-fragment types, five three-fragment types and one four-fragment type.

There are several different kinds of treatment of proximal humerus fractures: non-operative treatment with Desault, in undisplaced fractures; synthesis with percutaneous K-wires (two- and three-part fragments, good bone quality is required); cannulated screws of 4 mm (two-part fragments with valgus displacement); angular stability plate (three- and four-part displaced fractures); Cage (three- and four-part displaced fractures); Tension Guide Fixator (TGF; two- and three-part fractures, also in osteoporotic bone), and prosthetic replacement in comminuted and irreducible fractures [6,7].

The TGF is a minimally-invasive fixator that follows Newton's third law, for every action there is an equal and opposite reaction, whereby the voltage generated by the mechanism determines the contact between the fragments and the stability of the fracture.

The aim of this work was to establish the indications for TGF because besides the minimal invasiveness and simplicity of mounting, it is a system that enables only a closed reduction and has limited stability.

## Materials and methods

A total of 84 patients (56 women and 28 men) with a mean age of 61 years (range 42–84 years) with proximal end humeral fractures were treated with TGF from December 2007 to June 2012. The mechanism of injury for all patients was a fall from either a standing or walking position. A total of 66% of cases were two-part fractures and 34% were three-part fractures. According to the Neer classification, displacement of a fracture fragment by more than 1 cm or angulations of greater than 45° are considered significant; in these cases, surgery is necessary to preserve shoulder function [8].

## Surgical technique

The operation was performed under general anaesthesia with the patient in the supine position. Using fluoroscopy, the close reduction was achieved with external manipulation in 70% of cases; in the remaining cases, a 2 mm K-wire was used as a joystick to assist reduction. Two parallel K-wires were introduced in the head fragment from the upper lateral part of the humeral head and advanced into the medullary canal. Two fiches were then introduced into the humeral diaphysis. The K-wires were tensioned and connected to the “L” body and fiches (Figs. 1 and 2). The K-wire used as a joystick was usually fixed to the “L” body in the three-part fractures, while in the two-part fractures it was removed.

Postoperative recovery was rapid as commutators movements were allowed 24 h after treatment, and passive movement was permitted after 48 h. The active-assisted movements following this surgery are usually less painful than with other surgical techniques. Postoperative rehabilitation included pendulum, and passive and active-assisted range of motion (ROM) exercises of the shoulder, as tolerated. All patients were discharged within 2–3 days following surgery, with instructions for continuous physical therapy and daily care of the pin sites.



Fig. 1. External fixator instrumentation.

## Results

Routine follow-up, including clinical and X-ray examination of the shoulder and proximal humerus, was performed every 3 weeks for the first 2 months after surgery, every 2 months for the next 6 months, and then annually thereafter. Clinical examination included assessment of pain and pin sites for pin-tract infection, and evaluation of the Constant-Murley score (pain, function, ROM, and strength), the University of California Los Angeles (UCLA) score (pain, function, active and strength of forward flexion, and patient satisfaction), the Oxford score (pain and function in activities of daily living), and the Quick Disabilities of the Arm, Shoulder and Hand (DASH) shoulder score (pain and ability in activities of daily living and sports) [9–11]. Fracture union, function using the Constant-Murley score, UCLA score, Oxford score, and Quick DASH shoulder score, and complications were evaluated. Radiographic

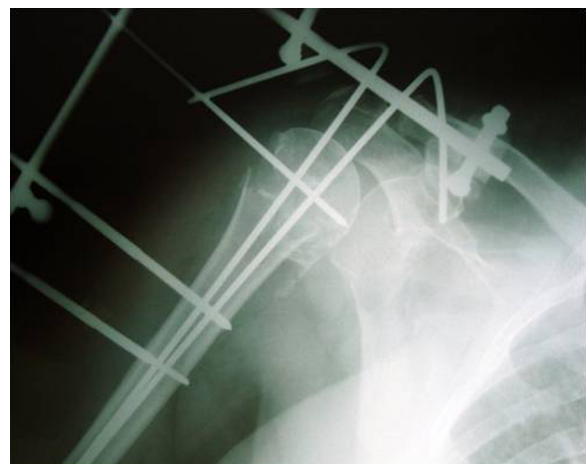


Fig. 2. Postoperative X-ray control.

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