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TECHNICAL NOTE

Distal radius fractures: Treatment using the Epibloc™ system

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Summary The Epibloc™ system of percutaneous endomedullary internal fixation is best indicated for AO type A2-3 extra-articular fractures of the distal radius and AO type C1 slightly comminuted articular fractures. This system includes pins that can be inserted into the medullary canal and advanced without breaking through the second cortex. This fixation is stabilised by an external plate and rendered dynamic by the pins' elasticity which compresses the fractured surfaces. Moreover, this system results in transversal ligamentotaxis which helps prevent secondary reduction losses. The result of a preliminary series of 326 cases is evaluated.

Introduction

The authors present results of the percutaneous Epibloc™ system which was developed in Italy for the treatment of distal meta-epiphyseal fractures of the radius [1]. The system is based upon the elasticity of pins which are introduced in the medullar cavity of the proximal radius and the distal epiphysis which they cross.

Principle and procedure

Two highly elastic, high caliber steel pins (35 cm long and 2.5 mm in diameter) (Fig. 1a) are supported proximally in the medullary cavity of the radius. The tips of the pins have a half-round on one side, so the distal epiphysis can be pierced and the medullary canal penetrated allowing the pins to be advanced internally without penetrating the second cortical layer. This procedure is possible once the tip has been turned under fluoroscopic control, so that the half-round side can slide along the internal cortex of the diaphyseal canal. Distal support is found where the pins cross the epiphysis in a direction, which will orient the elastic pressure produced by the pins. The system is stabilized by a small external plate where each pin is tightened with two screws (Fig. 1b). During fixation, the pins are pushed externally from each other. The elasticity of the pins compresses the fractured surfaces

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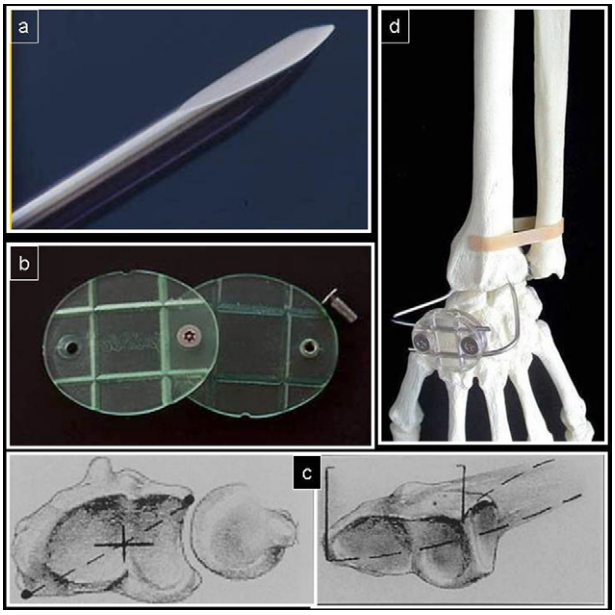

Figure 1 (a—b) Detail of the tip of the pin and the stabilizing plate (c—d) entry point of pins, drawn to the end of a line of junction which reaches the mechanical centre of the epiphysis.

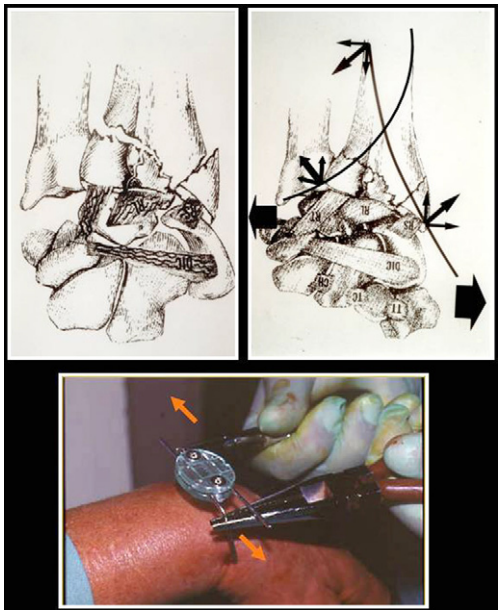

Figure 2 After manual reduction of the fracture, the pins are pushed into the medullary canal. They are folded orthogonally outside and pulled apart then stabilised by the plate. Radioscopically controlled separation makes it possible to impact the fracture.

on the epiphyseal side and exerts a ligamentotaxi effect on the other side. The tension of the fibroperiostal membrane simultaneously produces metaphyseal remodelling. The Epibloc should be considered a fixation technique and not a reduction technique and reduction should be obtained first, by the usual manipulations.

Plexic block is used for the surgical procedure. The patient is in the supine position with the arm resting on a flat surface. After manual reduction of the fracture controlled by fluoroscopy, a small incision is made to insert the pins while taking care of subcutaneous tendinous structures. The pins are inserted into the epiphysis of the radius with a motorized tool on the radial and cubital sides, more precisely at the internal dorsal angle of the epiphysis and the radial edge of the styloid, slightly dorsal to the long-abductor and short-extensor tendons of the thumb following a hypothetical line aimed at the mechanical centre of the epiphysis. (Fig. 1c—d). Once the fracture site has been passed, the pins are pushed into the medullary canal with the help of a hammer, using as much length as necessary, until they are blocked in the proximal radial epiphysis. Depending on the length of the forearm, 10 to 20 cm of pin remains beyond the bone outside the cutaneous plane. Two orthogonal folds are made in each pin with a clamp then the pins are attached to the plate pulling them apart from one another under fluoroscopic control, to compress the fragments of the fracture. (Fig. 2). The elasticity of the pins results in a movement that pushes down and outwards which tends to bring the fragments in contact with one another and to create transversal ligament tension (ligamentotaxis) realigning the articular arch.

In case of unstable fractures with associated ligament injuries, a third ulnar pin can be used which is also attached to the external plate and stabilizes the ulnar epiphysis. This provides major stability for union and favours healing of the distal ulnar—radial joint. Once the plate is in place, there is no need to immobilize the wrist. A bandage covers the entry points of the pins.

Description of the preliminary series

The preliminary series included 326 patients who underwent surgery from 2003 to 2006 selected on the basis of the following indications without randomization. There were 202 closed extra-articular type A2-3 fractures (including 147 dorsal displacements and 55 palmar displacements)

Figure 3 a—c. Fracture with dorsal displacement treated with the Epibloc system and X-ray results at three months.

Figure 4 a—c. Fracture with palmar displacement, significant cortical bone loss is seen after reduction (arrow). X-ray results at three months show recovery of bone density. No graft or bone substitute was used.

and 124 type C1 slightly comminuted intraarticular fractures [2] (Figs. 3—5). The mean age of patients was 48 years old (17—82 years old), 54% of the fractures were on the dominant side. The postoperative course included the following: clinical follow-up and X-ray on D7, bandage and clinical follow-up on D14 and D28 (with X-ray/removal of osteosynthetic material between D35 and D42 depending on the case. Clinical follow-up between D42 and D49 and physical therapy (necessary in 112 cases, or 34.3% of the series). Clinical follow-up and X-ray on D90 and clinical follow-up on D180. Before the procedure had been completely validated, the technique was shown not to be effective for certain types of fractures which were therefore excluded: marginal articular type B 1-2-3 fractures and complex C 2-3 fractures with several articular and metaphyseal fragments.

Results

Postoperative complications

The following complications were noted:

- 28 (8.5%) subcutaneous infections at the pin entry point, which were treated with antibiotics and which resulted in slight early removal of the system in 12 cases (3.6%) not affecting the healing of the fractures. Osteomyelitis did not occur in any of the cases;
- 9 cases (2.7%) of carpal tunnel syndrome, treated surgically;
- 6 cases (1.2%) of mild reflex sympathetic distrophy successfully treated with physical therapy;
- 5 cases (1.5%) of distal slipping of the pins (average 2 cm), which were surgically repaired with the same system. These cases of slipping were due to technical errors occurred in the first cases in the series, because the pins were not pushed and nailed into the spongy bone of the proximal radial epiphysis.

No tendinous, neurological or arterial iatrogenic lesions were reported from insertion of the pins.

Anatomical results

Radiographic results were grouped into anatomical results and malunions according to the SOFCOT 2000 symposium [3]. Malunions were classified as ''very moderate'' when they were less than 7.5°, ''moderate'' between 7.5 and 15° and ''significant'' greater than 15°. X-ray results were obtained on D1—D7, D28 and D90.

At the last follow-up on anteroposterior projection, the mean radial inclination was 22.6° [6.2—37°] and the distal radioulnar index was +0.2 mm [-0.5—+4.8 mm], no hypertranslation of the radial epiphysis was observed. On lateral projection, mean saggital inclination was 9° [-2.3—+16.3°]. Healing was obtained in all cases. The average delay to healing was 34 days [28—66 days]. Healing was delayed in 16 cases (4.9%). A ''very moderate'' or ''moderate'' malunion was observed in 149 cases (45.7%) due to incomplete anatomical manual reduction, and not secondary loss of reduction. On the other hand, eight (2.4%) cases of ''significant'' malunion were observed due to loss of reduction; the bone was severely porous in five cases, and technical surgical errors occurred in three. Pseudarthrosis did not develop in any patients (Table 1).

Functional results

Based on the Herzberg functional score of 100 [4], there were: 97 cases (29.7%) of excellent results, 155 cases (47.5%) of good results, 61 cases (18.7%) of average results, 13 cases (4%) of poor results. In particular, the poor results included

Figure 5 a—c. Articular fracture. A third ulnar pin is held in place by the external plate. Radiographic results at three months.

three cases of subcutaneous infection, four cases of delayed healing and six cases of significant malunion.

There was no residual pain in 158 cases (48.4%), pain was moderate during physical activity in 142 cases (43.5%), was present during simple movements in 24 cases (7.3%), pain was moderate even during rest in two cases (0.6%). Mean recovered amplitude of wrist mobility was 54° extension, 56° flexion, 78° pronation, 71°supination. Mean wrist strength on the Jamar® test was 28.7 kg on the operated side compared to 33.4 kg on the healthy side or 86% recovery of wrist strength. Finally, the mean DASH score on a self-administered questionnaire [5] was 8.5 (range 0.8—34).

Table 1 Anatomical results in 326 patients at six months.

Extra-articular fracture with dorsal displacement	
Mean frontal inclination (°)	23.1
Mean Distal radioulnar index (mm)	+0.3
Mean saggital inclination (°)	7
Extra-articular fracture with palmar displacement	
Mean frontal inclination (°)	20.3
Mean Distal Radioulnar index (mm)	−0.2
Mean sagittal inclination (°)	13
Intra-articular fracture	
Mean frontal inclination (°)	16.3
Mean Distal Radioulnar index (mm)	0
Mean sagittal inclination (°)	10
Anatomical healing	169 cases (51.8%)
Very moderate/moderate malunion	149 cases (45.7%)
Significant malunion	8 cases (2.4%)
Delayed healing	16 cases (4.9%)
Pseudarthrosis	0 cases

Comments

The Epibloc™ system is a surgical technique for the treatment of numerous wrist fractures. These fractures, treated by manual reduction and percutaneous pinning can result in excellent mobility as well as a low rate of complications and secondary loss of reduction. It has the advantages of other percutaneous systems: no tissue adhesions or cutaneous scars, no exposure of the fracture site, and preservation of the hematoma, which is considered the primary element in the development of a fracture callus [6]. It has been shown to be reliable, simple to perform and reasonably priced. This system is partially dynamic and compresses the fracture surfaces with transversal ligament tension, which helps maintain fracture reduction. Finally, the use of a third pin inserted into the ulna and stabilised with the external plate, stabilizes distal radioulnar articulation in cases of associated ligament injury. The method is not effective or indicated for free articular fragments, marginal articular fractures, treatment of complex fractures or significantly comminuted fractures. Based on responses to a self-administered questionnaire on quality of life, the system was well tolerated by patients who were followed-up as outpatients, and Epibloc™ resulted in a rapidly mobile wrist, allowing physical therapy to begin early.

Conflict of interest

None.

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