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ORIGINAL STUDY

Treatment of Gustilo grade III B supracondylar fractures of the femur with Ilizarov external fixation

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Twenty patients who had been treated with Ilizarov external fixation for a Gustilo grade IIIB supracondylar fracture of the femur were functionally assessed 12 to 52 months after treatment . Fourteen fractures were type C3 and 6 were type C2 according to the AO classification. Fractures were united at an average of 39 ± 9 weeks. There was a final knee extension deficit of 5° to 10° (12.2° ± 3.5°) and flexion reached 110° ± 10° in type C2 and 73° ± 36° in C3 supracondylar fractures. Forty percent of the supracondylar fractures had 4cm shortening and 40% had 1.5 cm. Pin-track infection occurred in 21%. Half of the C3 fracture cases had problems with pain on walking, needed support and had pain at rest, whereas no patients had difficulty getting out of a chair, going up and down stairs. However, all C2 type fractures had problems with all types of function.

Keywords : Ilizarov external fixator ; supracondylar fracture ; functional outcome.

INTRODUCTION

Supracondylar femoral fractures usually require surgical treatment to obtain an anatomical and stable fixation and a good result. These fractures usually occur in elderly patients with multiple co-morbidities and osteoporotic bone. A high rate of complications can be expected. Severely comminuted distal femoral fractures are especially difficult fractures to treat properly, to obtain reduction and a stable internal fixation. Metaphyseal fractures may extend into the joint and the diaphysis, which further increases the complexity of their management (*3*) (fig 1 a,b).

Stabilisation of short periarticular fragments is possible with a circular external fixator. The use of a circular external fixator for acute trauma of the upper and lower extremities is common in Russia and part of Western Europe, and is increasing in North America (*7*). The treatment guidelines for closed fractures can be applied in the presence of Gustilo type I or II open wounds. However, a type III, especially a III B wound, necessitates immediate aggressive debridement of nonviable tissues, stabilisation with an external fixator, either primary or delayed primary skin closure, and early mobilisation and weight bearing. The goal in

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Fig. 1a. — AP radiograph of the distal end of the femur

Fig. 1b. — Lateral view of the distal end of the femur

treating supracondylar femoral fractures, as with any periarticular fracture in a weight-bearing bone, is restoration of a stable limb in anatomic alignment and length. Stability is initially achieved by fixation and eventually by bone healing. Early mobilisation prevents stiffness and restores function and pain-free ambulation.

We analysed the functional recovery and the clinical effectiveness of Ilizarov external fixation in the acute treatment of severely comminuted extra-articular and intercondylar fractures of the distal femur.

PATIENTS AND METHODS

This study involved a consecutive series of 20 patients with a Gustilo grade IIIB open distal femoral fracture (fig 1), treated at BP Koirala Institute of Health Sciences, Dharan, Nepal, between August 2000 and August 2004. All twenty patients were male and between 27 and 58 years old (mean age : 37 ± 11 years). Fourteen had a C3 and 6 a C2 fracture according to the AO classification. All patients were followed for 12 to 52 months.

Initial resuscitation, splintage and primary care for the wound were provided in the emergency room. Any protruding bone fragments were covered with sterile dressing. The patients were then taken to the operating room and treated by pulse lavage and wound debridement, followed by external fixation of the fracture. All fractures were stabilised with two rings in the lower fragment (a 5/8 ring in the lower most, and a full ring more proximally) connected with threaded rods to one 5/8 ring and at required distance an Italian arc in the proximal fragment. Schanz pins were used in proximal fragments of supracondylar fractures. When removal of loose detached small fragments was necessary or where bone loss existed, bone ends were approximated. “Acute shortening” was helpful in primary and delayed primary

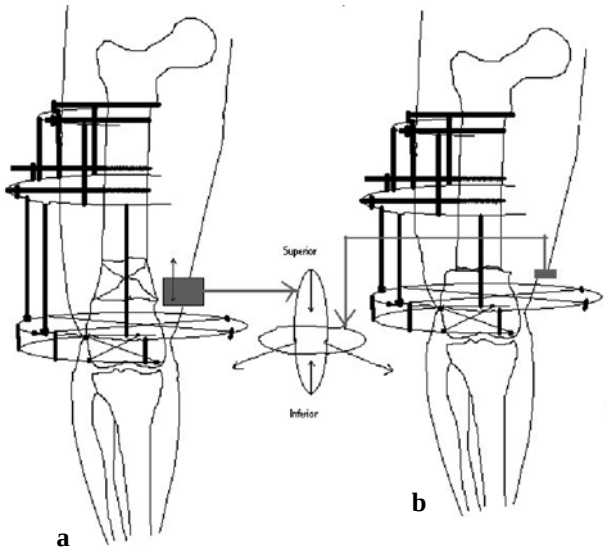

Fig. 2. — **a.** Diagrammatic representation of Ilizarov fixator. The red rectangle illustrates the soft tissue injury ; **b.** Diagramatic representation of Ilizarov fixator. After shortening at the fracture site, the longitudinal wound is converted into a transverse wound.

wound closure (fig 2 a,b). Acute shortening was necessary in 80% of cases. Shortening allowed for approximation of the superior and inferior edges of the transverse cuts in the soft tissue without tension, and conversion of longitudinal cuts into transverse cuts to decrease circumferential fibrosis was also facilitated. Attempts were made to cover the exposed part of bone with soft tissue in all cases.

Accuracy of reduction was routinely controlled with an image intensifier.

The patient and his caretaker were taught how to clean the wires and rings. Regular pin track cleaning was advised (at least twice a day) with a betadine solution or alcohol. All patients were made to stand with support after 48 hours, knee mobilisation started within the limits of pain. Weight bearing (either partial or full) was started according to clinical and radiological progress. Wounds were inspected at an interval of 48-72 hours and repeated debridements were done whenever required.

Split thickness skin grafting was performed within 3 weeks of primary surgery.

We did secondary bone grafting in all cases after 10 to 12 weeks . The progress of bony union was assessed clinically and radiologically at 6 weeks intervals, till union was sound. Radiological bony union was accepted when there was evidence of periosteal bridging and

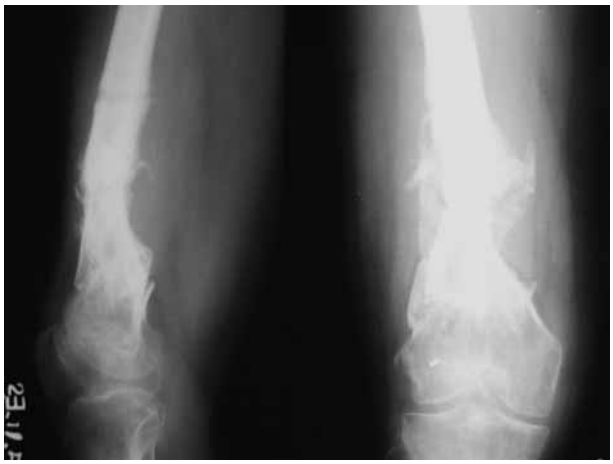

Fig. 3. — Follow up AP & lateral radiographs showing union

obliteration of the fracture line by endosteal callus formation. Satisfactory wound healing and a good amount of endosteal and periosteal callus formation were taken as the criteria for removal of the fixator. A knee brace was not used.

After union was obtained clinical and functional assessment criteria were : pain on walking, pain at rest, functional abilities such as getting out of a chair or going up and down stairs, the need for a walking aid, and clinical fracture stability as checked by the physician.

RESULTS

Bony union was obtained in all fractures at 39 ± 9 weeks (fig 3). An extension deficit of 5° to 10° (mean : 12° ± 3.5°) was noted. The total range of movement of the knee in C2 type supracondylar fractures was 110° ± 10°, and 73° ± 36.5° in type C3.

Forty percent of the supracondylar fractures had 4 cm shortening and another 40% had 1.5 cm shortening. Pin-track infection occurred in 21% and resolved after intravenous antibiotics and care of the pin sites. No patient required a secondary procedure because of loosening of the frame with loss of reduction.

Problems with all types of function were observed in all C2 type supracondylar fractures. Fifty percent of the C3 fractures had pain on walking, needed an external support and had pain at

Fig. 4. — Intraoperative AP & lateral radiographs

rest, whereas none of the patients with a C3 fracture had any problem getting out of a chair or going up and down stairs.

DISCUSSION

Early aggressive debridement of non-viable tissues, stabilisation with an Ilizarov external fixator, and either primary or delayed primary skin closure followed by early mobilisation and weight bearing is a sound alternative treatment method for comminuted Gustilo Grade IIIB supracondylar and intercondylar fractures of the distal femur (*13*). The Ilizarov external ring fixator has considerable advantages : a short operating time, low blood loss, minimal surgical exposure, no additional periosteal stripping with possibly quicker healing of the fracture, and greater mechanical stability than with a monolateral external fixator (*4, 5, 7, 11*). With the Ilizarov system the diverging olive wires offer additional stability and a firm compression effect on the condyles (fig 4).

In our experience and in other reported studies, the most disabling complication was loss of knee movement (*1, 2, 5, 9, 11*). The anatomical type of the fracture and the severity of the associated soft-tissue damage are primarily causing this complication. The wires and pins used in the femur pass through the quadriceps muscle, thereby acting as a checkrein to the movement of the knee while the fixator is in place. For this reason we carried out the operation on a traction table and in a position of moderate knee flexion, in accordance with Ilizarov's original description (*8*), thus stretching the extensor mechanism of the knee. Although there are reports of better movement after treatment with unilateral fixators, these reports included all subgroups of type-C fractures and even type-A3 fractures (*1, 11*).

Construction and assembly of the frame are easier using a traction table, which allows better control and easier adjustment of the rings.

In our experience, the use of an Ilizarov external ring fixator in the treatment of Gustilo IIIB supracondylar fractures offers several distinct advantages, although the indications for its use are very specific (*12*). On the basis of our experience, we suggest adopting this method for functional limb salvage after compound high-energy injuries. This fixator is safe and versatile, is effective in providing stability and allowing early rehabilitation. There is no need for free and local skin flaps (*10*). The issue of the soft-tissue lesions is complex. Because of the anterolateral curvature of the femur, the wound is usually anterolateral. With reduction of the fracture, the wound is longitudinally stretched, its anterior and posterior lips approximate and the wound tends to close. In supracondylar fractures, there is usually a dead space behind the femur in the popliteal fossa. This dead space closes during anatomical reduction, and drainage from that space is blocked. The medial intermuscular septum, the biceps, the deep fascia may also contribute to blocking this opening. The resulting stasis may lead to infection. With acute shortening, the longitudinal soft-tissue gap converts to a transverse gap and the popliteal fossa can drain properly, reducing the risk of infection. Since shortening also reduces the bone gap, it is likely to encourage fracture union.

The external fixator is intended to be a definitive treatment, enabling early functional loading.

In this series, only 50% of type C3 fractures were problem free. The remaining 50% had problems with three of the six parameters of function. However, all C2 fractures had problems with all parameters of function.

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