Treatment of Distal Femoral Fractures with Ilizarov Frame

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Introduction

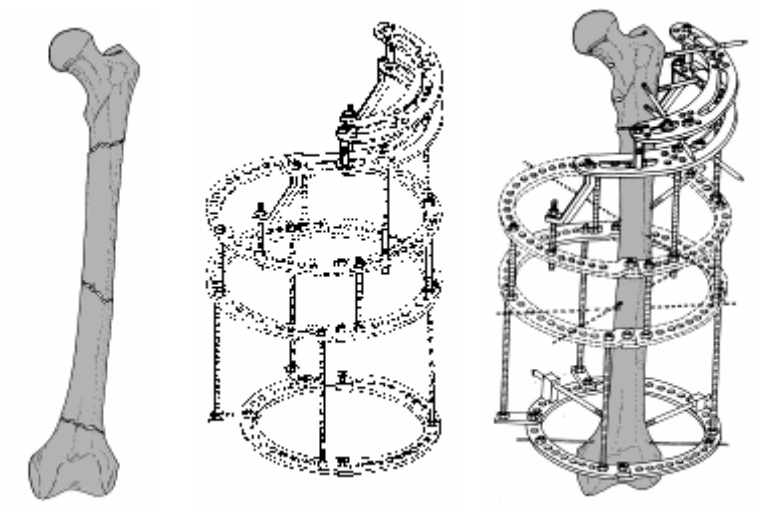
The Ilizarov technique has been used extensively at the Institute of Kurgan in the treatment of a wide variety of fractures. In the western world, other successful treatment modalities have made the indications for the application of an Ilizarov apparatus more limited. Basically, its use has been limited to extremely complex open fractures where the use of internal fixation may be contraindicated.

Because of our experience at the Hospital of Lecco, the monolateral fixator is preferred in the treatment of complex humeral fractures since it gives sufficient stability and is well tolerated by the patient. The only indication for the application of the circular fixator in humeral fractures is with bone loss. In forearm fractures, the indication for an Ilizarov device is limited to open and/or severely comminuted fractures that can not be reduced or sufficiently stabilized with a monolateral fixator. In the lower extremity, the ring fixator is indicated for treatment of comminuted, segmental and open fractures as well as those with bone loss. The advantages of this technique of fracture management in such cases outweigh the potential disadvantages.

The general technique of assembling an Ilizarov fixator will be presented with special attention being given to the specifics of lower extremity fixation.

Fractures of the femur (Fig. 1)

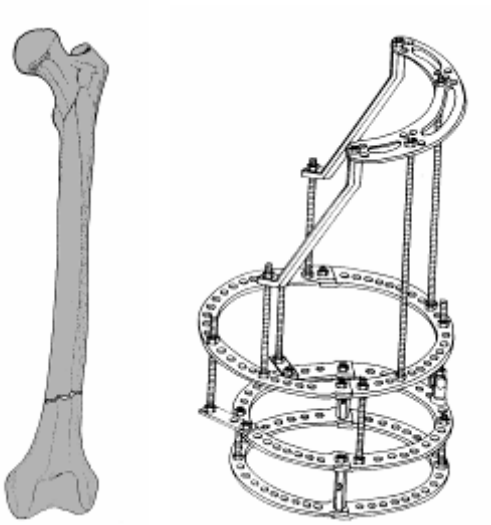
The standard assembly includes incorporating a full ring distally and an arch proximally at the subtrochanteric level. One or two intermediate rings or arches will be incorporated into the fixator depending on the type and level of the fracture (Fig. 2). Fixation distally includes a transverse wire and two half-pins, one inserted from posteromedial to anterolateral and the other from posterolateral to anteromedial. Proximal fixation is achieved by attaching two half-pins to the arch. The first is placed from posterolateral to anteromedial and the second from anterolateral to posteromedial. At the intermediate ring or rings, olive wires have been used traditionally to reduce and hold the fracture fragments in alignment. Unfortunately, olive wires are not well tolerated by the patient for the duration of treatment. Therefore, half-pins should be applied to the intermediate rings, trying to stay



posterior to the iliotibial band so that knee motion is not hindered. Once this is accomplished, the olive wires can be removed (Fig. 3). Frame construction, wire and half-pin placement will be presented for proximal, diaphyseal and distal fractures of the femur. Preassembly of the frame is recommended in order to make application easier and to reduce operating time. Basic configurations can be used and modified as necessary. For fractures in the upper third of the

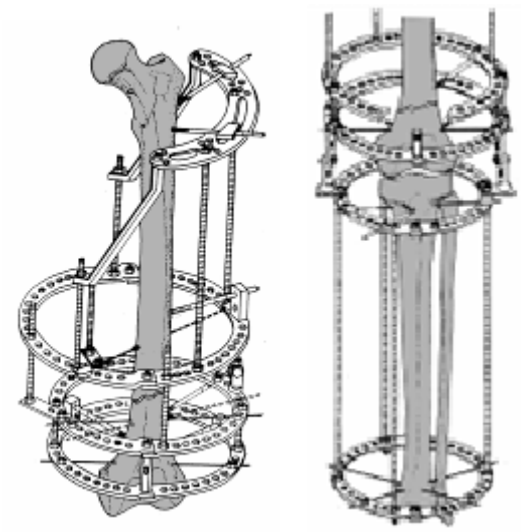
femur, two arches and two rings are recommended. In middle and distal third fractures, one arch and three rings are used.

Fractures of the distal femur (Fig.13)



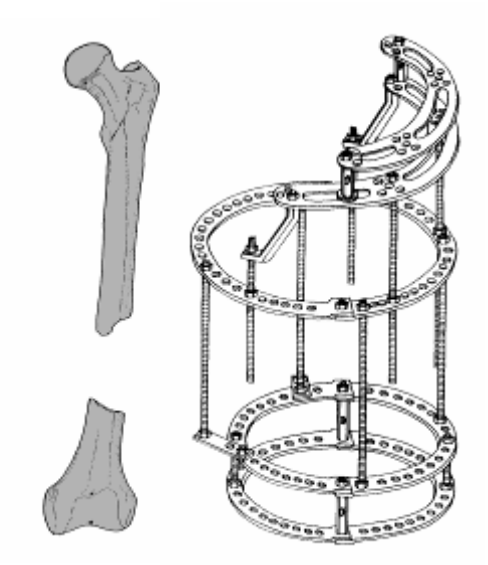
In a manner similar to what has been described for the tibia, there must be two levels of fixation for each major fragment in a distal femoral fracture. The pre-assembled frame will include two distal rings connected with hexagonal sockets measuring 2, 3 or 4 cm, depending on the length of the distal bone fragment. The proximal block will consist of an arch at the subtrochanteric level and one ring. The size of the rings should correspond to the cone shape of the thigh and may be of a smaller diameter distally (Fig. 14).

At surgery, the frame is applied to the thigh and the reference wire is inserted from lateral to medial at the base of the condyles and perpendicular to the anatomical axis of the femur. Rotational alignment is achieved next. Proximally, a half-pin is inserted in the femur from posterolateral to anteromedial and is attached to the arch while keeping the frame centered (Fig. 15). A radiographic image will be needed to check the alignment of the fracture and, if needed, olive wires can be used to improve the reduction. For this purpose, the olive wires should be applied to the rings closest to the fracture. Next, a half-pin would be inserted from anterolateral to posteromedial and fixed to the proximal arch. On the distal ring of the proximal block, a wire is inserted from posterolateral to anteromedial, passing anterior to the artery. A half-pin is inserted at this level almost parallel to the preceding wire. On the proximal ring of the distal block, a half-pin is placed from posterolateral to anteromedial and a wire from lateral to medial. At the distal ring, two half-pins will be inserted as previously described. Again, in large patients, an additional half-pin can be inserted from posterolateral to anteromedial at the distal ring of the proximal block (Fig. 16).



A variation is needed when the distal fragment is small and there is not enough space for two distal rings. This frame will have an arch and only two rings, with the distal ring being secured to the distal femur with multiple wires or preferrably a reference wire and two half-pins. If this does not provide adequate stability, a tibial frame can be added. This would consist of two rings, one proximal and one distal, secured to the tibia with two wires at each ring or one wire and one half-pin. The tibial frame would then be connected to the femoral frame using two simple hinges at the axis of rotation of the knee (Fig. 17). This will allow knee motion during treatment. An anteroposterior view of the united distal femoral fracture is shown.

Fracture of the femur with bone loss (Fig. 18)



In the case of a fracture of the femur with bone loss, with or without shortening, the strategy is to eliminate the bone loss and restore the normal limb length. The pre-assembled frame is to be constructed using two arches proximally connected with hexagonal sockets and then attached to a ring. The distal block will consist of two rings (Fig. 19). The proximal arch will be at a level between the greater and lesser trochanter, the intermediate ring approximately 3 cm proximal to the area of bone loss and the proximal ring of the distal block about 3 cm distal to the fracture. A distal reference wire is inserted in the usual manner. Rotational alignment and fracture reduction must be accomplished at this stage of the operation. Next a half-pin is inserted at the proximal arch from posterolateral to anteromedial making sure to stay perpendicular to the proximal segment of femur (Fig. 20). One wire is inserted at the intermediate ring and another on the proximal ring of the distal block. Two half-pins are inserted at the distal ring as described previously. Half-pins are also inserted at the proximal ring of the distal block and at the intermediate ring in a posterolateral to anteromedial direction. A half-pin is also placed on the proximal arch from anterolateral to posteromedial at an approximate 60 degree angle to the initial half-pin. Two half-pins are placed on the distal arch of the proximal block parallel to the half-pins on the proximal arch. A corticotomy is done in the subtrochanteric area and after a five to ten day latency period, distraction can begin with a rhythm of 0.5 to 1 mm per day, depending on the biologic response of the regenerate (Fig. 21). Bone transport is continued until the defect is corrected. In some cases it is better to shorten the deficient bone at the fracture site in order to achieve bony contact in a more rapid manner. At the time of docking, resection of the irregular bone ends will be done in order to obtain a larger surface area of bone to bone contact and then compression can be applied more successfully. If the site of docking site in not infected, bone graft may be applied. The frame must be left in place until both the regenerate and the docking site have healed (Fig. 22).