Treatment of Diaphyseal Femoral Fractures with Ilizarov Frame

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Introduction

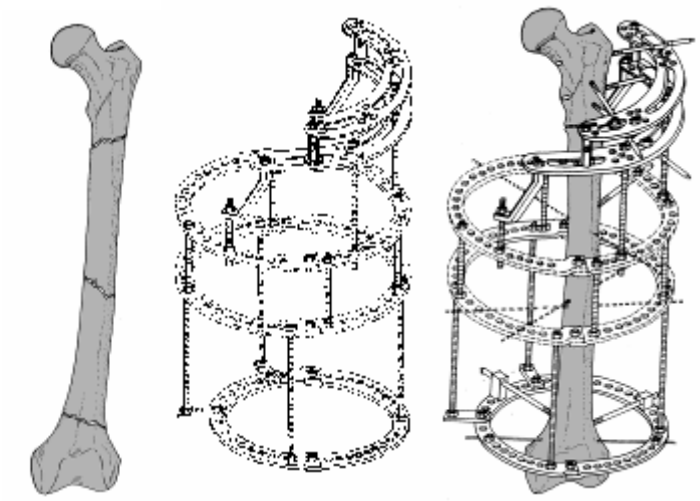
The Ilizarov technique has been used extensively at the Institute of Kurgan in the treatment of a wide variety of fractures. In the western world, other successful treatment modalities have made the indications for the application of an Ilizarov apparatus more limited. Basically, its use has been limited 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).

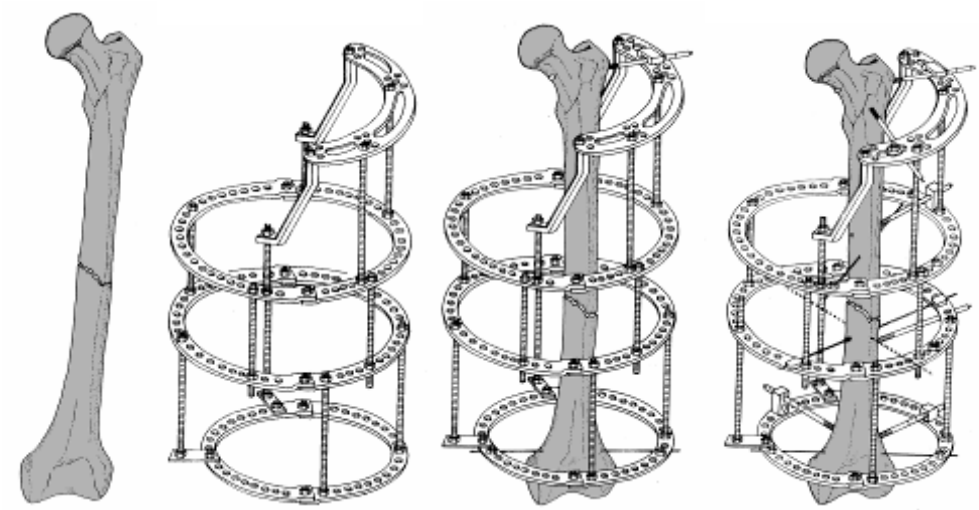


Fixation distally includes a transverse wire and two half-pins, one inserted from posteromedial to anterolateral and the other from posterolateral to anteromedial. Proximal fixation is achieved by attaching two half-pins to the arch. The first is placed from posterolateral to anteromedial and the second 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.

Diaphyseal fractures (Fig. 9)

This pre-assembled frame will always have four levels and be constructed in a manner to allow 5-6 cm between each component of the upper and lower block. This should allow for an unobstructed radiographic view of the fracture. The proximal block will consist of a 90 or 120 degree arch connected to a ring which will provide more stability. The distal block will consist of two rings, the more distal ring possibly of a lesser diameter due to the conical shape of the thigh (Fig. 10).



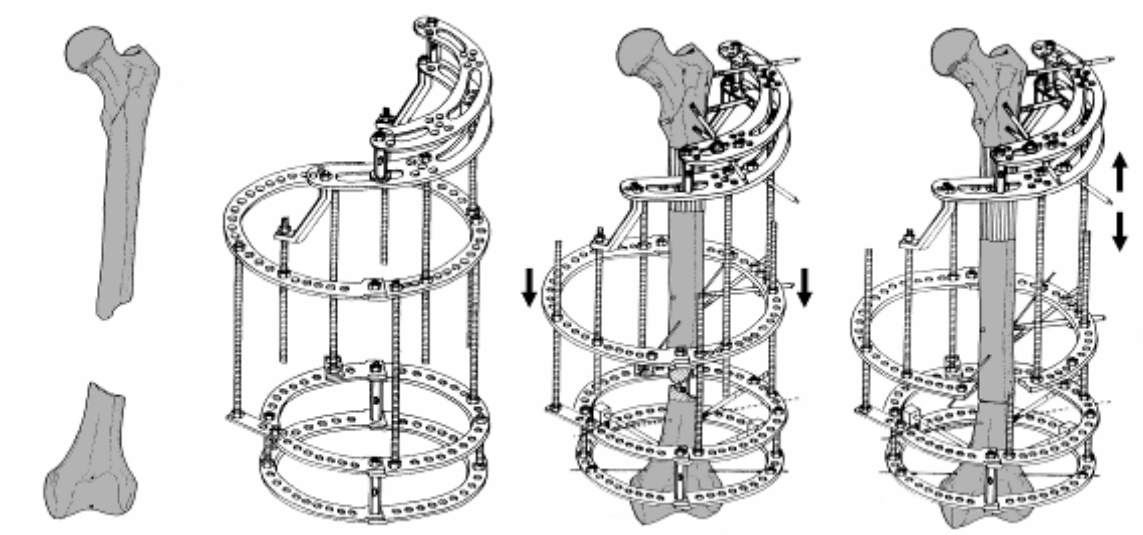
The frame is applied to the thigh in the operating suite. Again the distal reference wire is inserted from lateral to medial in a transverse direction at the base of the condyles and perpendicular to the anatomic axis of the femur. The frame must be centered and coincide with the anatomic axis of the femur. After rotational correction, a proximal half-pin is inserted from a posterolateral to anteromedial direction at an angle of approximately 30 degrees from the frontal plane of the patient and fixed to the arch (Fig. 11). Make sure that proper spacing has been maintained between the frame and the skin. If the thigh is extremely large or fleshy, there will be less risk of edema and irritation if the intermediate rings are applied at a minimum distance of 3 cm from the proximal and distal rings. After reduction as previously described, the stability of the construct is secure. A second half-pin is inserted from the opposite face of the arch at about a 70-90 degree angle from the initial half-pin. A third half-pin is inserted from posterolateral to anteromedial and fixed to the distal ring of the proximal block. At this same ring, a wire is inserted from posterolateral to anteromedial passing anterior to the femoral artery.

At the ring closest to the knee, two half-pins are inserted in exactly the same manner as described in the previous section. A wire is inserted from posteromedial to anterolateral passing anterior to the femoral artery and then attached to the proximal ring of the distal block. The next

wire requires accurate placement. At a 90 degree angle from the above wire and on the opposite face of the same ring, another wire is inserted posterior to the femoral artery. In cases that have had previous intervention, scarring and tissue retraction could displace the femoral artery from its normal anatomical location and place it in harms way. A half-pin can be safely substituted for this wire in doubtful cases.
Note that the femur is affixed to the frame at each level by at least two supports; two wires, one wire and one half-pin or two half-pins (Fig. 12). In large patients or those with marked osteoporosis, an additional wire could be added to the distal frame and a half-pin to the proximal arch. The example is both a diaphyseal and distal femoral fracture and therefore has an additional ring. Post operative care and compression, if desired, can proceed as already described and the frame must remain in place until the fracture has healed.

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).