Ten Basıc Rules for Ilizarov Applications

7

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7.1 Being Careful for Anatomic Structures

The first rule for the circular external fixator (CEF) application is being careful for the anatomic structures while placing wire and screws. The anatomy atlas must be studied before surgery, or the patient can even be brought to the operation room [1–5]. Thus, neurovascular injury rates can be decreased to as low as possible (Fig. 7.1).

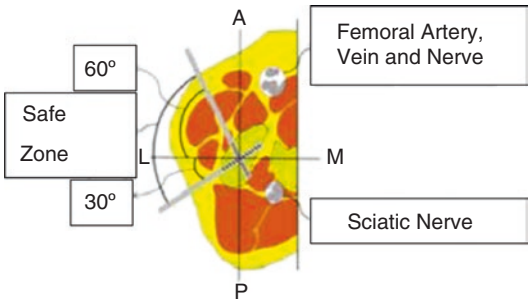

Fig. 7.1 Positioning of Schanz screws properly to the anatomic structure

7.2 Biomechanical Features of Kirschner Wires and Schanz Screws

Trocar tip K-wire for spongious bone and bayonet tip K-wire for cortical bone should be used. K-wires can be tensioned up to 120 Nw/m at distal femur and proximal tibia. The biomechanically strongest combination can be obtained by using K-wires and Schanz screws together. Wires and screws should be placed at 60° angle while caring for anatomic structures. The use of one K-wire and two Schanz screws for distal femur and proximal tibia (delta shape) is the strongest combination (Fig. 7.2).

Schanz screws can be placed directly at metaphyseal site, but it should be drilled first while placing at diaphyseal site to protect the

Fig. 7.2 One K-wire and two Schanz screw application in delta shape

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bone. Because of the fracture risk, the diameter of Schanz screws should not extend more than one third of the diameter of the bone. Also, hydroxyapatite coating screws should be used in lengthening procedures because of better adherence [1].

7.3 Features of Application of Kirschner Wires and Schanz Screws

K-wires and Schanz screws should be cleaned with alcohol before application and held with sterile material soaked with alcohol for helping proper angulation while placing. A low-speed drill (30–40 rpm) should be used to prevent bone necrosis. After crossing the second cortex, wire should be pushed forward using a hammer or a drill with lower turnover. In this way, neurovascular tissues will not twist around the wire at the exit site [2, 3, 5]. To prevent tissue necrosis at the wire and screws entry site, the tissue should be widened using a lancet, and if necessary, an offset construction can be built with additional tools (Fig. 7.3).

Fig. 7.3 Fixation of the wire to the system with offset construction

7.4 Building the Frame

Circular external fixator (CEF) should be prepared before the procedures for both fractures and deformities. In this way, a lot of time is saved compared with preparing it during surgery. However, the surgeon should keep in mind that the connection parts of the carbon ring frames can loosen during sterilization process and must be tightened. Bone fragments should be fixed at two different levels. The rings must be positioned at least 3 cm off the fracture site and perpendicular to the axis of fracture fragments [1, 3, 5]. The rods must be parallel to the bone axis. If two rings for one fragment are not possible, fixation must be augmented with offset fixation (Fig. 7.4).

L-connectors can be used for medial support, especially for CEF for the femur, to achieve adequate stability (Fig. 7.5).

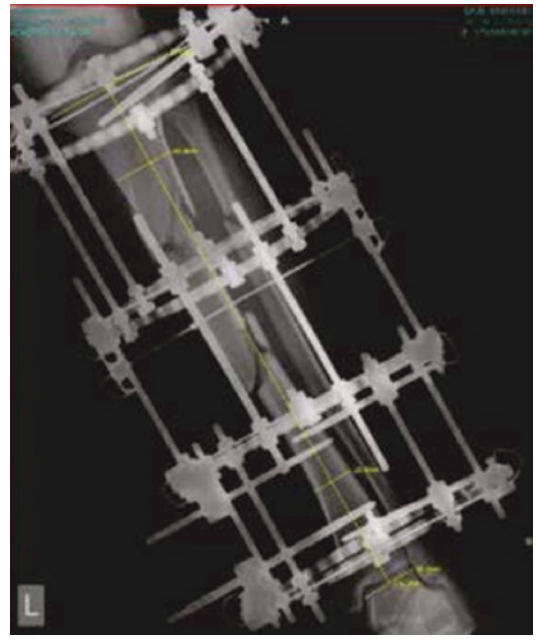

Fig. 7.4 A proper Ilizarov frame

Fig. 7.5 Building a stable frame around the femur and use of L-connectors

7.5 Positioning of the Hinges

Hinges are widely used in deformity surgery although they can also be used in some fractures to obtain anatomic reduction (Fig. 7.6). When hinges are positioned on the fracture site, they enable frame movements for angulation. When they are positioned more proximally or distally, they can be used for correcting both angulations and translations [1]. For lengthening, hinges should be positioned at the convex side. For correcting rotational deformities, translation devices should be used.

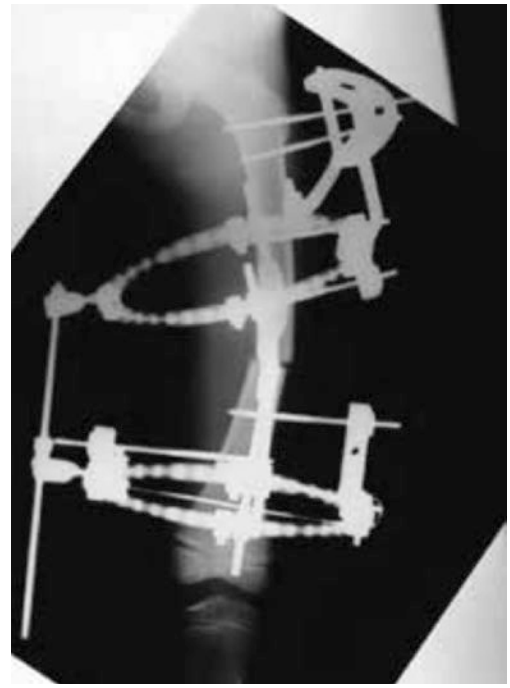

Fig. 7.6 Correction of a deformity of a femur using hinges

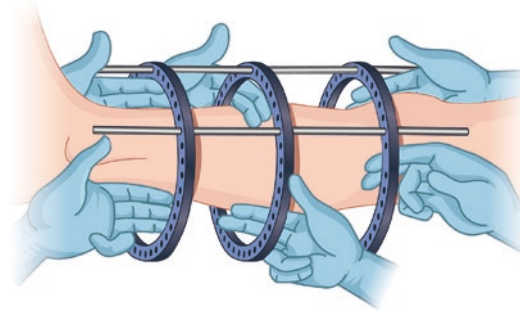

Fig. 7.7 Two-finger rule in circular external fixator application on tibia

7.6 Fixation of Circular External Fixators (CEF) to the Bone

The adequacy of space between the skin and rings should be checked before fixation of the CEF (two-finger rule) (Fig. 7.7).

For this, a ring with an appropriate diameter should be selected before surgery. Screws and wires

must be positioned perpendicularly to the bone axis; first proximal and then the distal wires and nuts should be fixed for tibia, and first distal and then proximal wires and nuts must be fixed to the femur taking care that the rods are parallel to the axis of the bone. All procedures should be performed under fluoroscopy, and it should be checked with AP and lateral X-rays if there is suspicion about orientation and alignment [4] (Fig. 7.8). After the alignment is obtained, the frame should be completely fixed using sufficient K-wires and Schanz screws.

7.7 Safety of the Soft Tissue and the Surgeon

To prevent necrosis in the soft tissue, all entry and exit sites of wires and screws should be widened using a lancet. Especially if a K-wire's exit site is far from the ring, it must not bend over the ring; instead it should be fixed using posts. K-wires and screws should be covered with plastic caps after cutting to protect both the patient and the surgeon (Fig. 7.9).

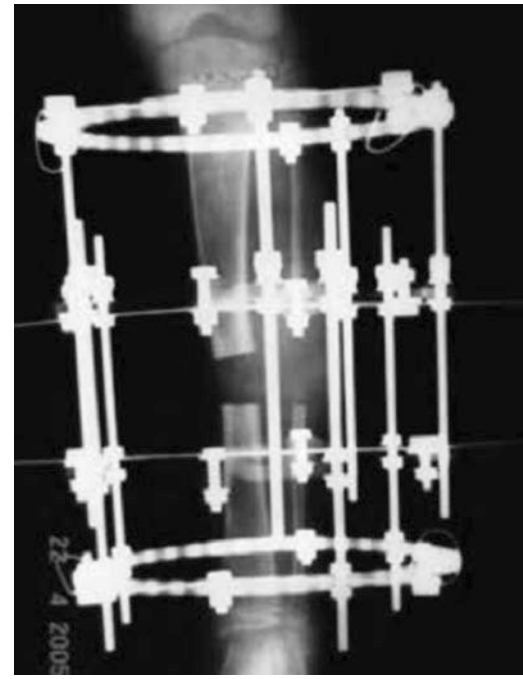

Fig. 7.8 Positioning of reference wires

Fig. 7.9 Covering screw ends with plastic caps

Fig. 7.10 Including the foot in the frame

7.8 Including Adjacent Joint to Fixation

For fractures close to the joint at the distal tibia (closer than 4 cm), and when lengthening is planned, especially at the metaphyseal site, the foot should be included in fixation to prevent equinus contracture [3, 4] (Fig. 7.10). For fractures at the knee, if the fracture is closer than 4 cm or the tibial plateau is broken, the knee joint should be included in fixation using a ring at the distal femur.

7.9 Osteotomy

Most of the time, osteotomy is unnecessary for primary bone osteosynthesis at fractures, but it should be done on the proper level to equalize extremity length in fractures with bone loss. Osteotomy can be achieved through multiple drilling or using a Gigli wire (Fig. 7.11). To obtain high-quality

Fig. 7.11 Osteotomy made with using the multiple-drilling method

regeneration, principles of distraction should be carefully observed such as protecting periosteum, waiting for the latent period (7 days), and 1 mm elongation per day (0.25 mm per 6 hours) [3].

7.10 Rehabilitation

One of the best advantages of the circular external fixator and Ilizarov's philosophy is providing early movement and weightbearing of the patient, or as much as can be tolerated. Along with protecting joint contractures in the early period, also an early return to work is possible for these patients. As a result, patient's compliance for the treatment increases and high motivation brings more successful results.

Even though higher success rates and fewer complications are possible when these ten basic rules are followed, sometimes successful results cannot be achieved, notably with open fractures, fractures with multiple fragments or bone loss, and one third distal tibia fractures that have higher rates of pseudoarthrosis. However, by following the ten rules in this chapter, osteosynthesis is more possible even in the fractures mentioned above, and by allowing adjustments on the frame, adding Schanz screws and K-wires, consecutive distraction-compression applications (accordion

technique), and grafting could bring success to the treatment. For this reason, even in difficult fractures, these "ten basic rules" will bring better success rates and fewer complication risks.

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