

THE METHODS OF ILIZAROV

small-wire, external fixation
distraction osteogenesis
limb lengthening
bone transport

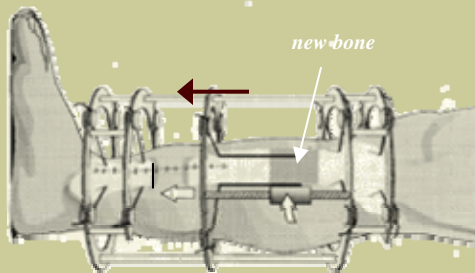
The instrument most commonly used to repair significant defects in bone is an external fixator designed by the Russian surgeon, Gavriil Ilizarov. To stabilize the extremity during repair, the device attaches to the normal skeleton, on either side of the injury, with sets of small, crisscrossed wires (*figure*). To repair segmental, bone defects, various methods are utilized:

- (1) *shortening* the frame and limb to allow end-to-end healing.
- (2) *bone transport*: an internal, segmental lengthening (*figure*).
- (3) *compression/distraction*: a combination of methods wherein the bone is simultaneously shortened and the limb lengthened, with or without an interval of bone transport.



THE ILIZAROV FRAME

Pins and wires, pass through the bone and soft tissues to connect with a set of rings .



BONE TRANSPORT: *the frame moves a segment of healthy bone across a defect, generating a new, immature bone (regenerate) in its wake.*

DEFINITIONS

OSTEOTOMY: a surgical cut in the bone.

DISTRACTION: the process of pulling the osteotomy apart.

DISTRACTION GAP: distance created by distracting the osteotomy

REGENERATE: tissue forming in the distraction gap.

CONSOLIDATION: the maturation of the regenerate into bone.

DOCKING SITE: the contact surface for the transport segment at the far side of the defect.

UNION: bone healing between opposing bony surfaces.

HOW DOES IT WORK?

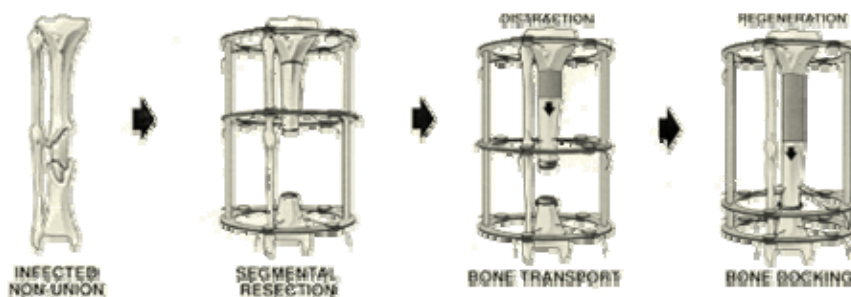
PRINCIPLE: when applied appropriately, tension can stimulate and create new-tissue growth.

DISTRACTION OSTEOGENESIS: the creation of bone through a tension.

BONE TRANSPORT: using distraction principles to restore a segmental bony defect by moving one bone segment relative to another.

The protocol: The wound is debrided (see *OSTEOMYELITIS* and *TREATMENT PROTOCOL*), and the limb stabilized with a transport frame. A length of bone, above or below the defect, is then prepared: it is fixed to the frame with wires; an osteotomy is gently performed to separate the chosen piece from the remaining bone -- this piece will be the *transport segment*. Injury from the osteotomy will also initiate a local, reparative process (the regenerate). When the frame slowly moves the *transport segment* toward the defect, the regenerate is placed under tension (distraction) and elongates to completely fill the distraction gap. When distraction stops at the end of transport or lengthening, the regenerate is allowed to consolidate into bone. The new, generated segment is exactly the length of the original, bony defect. Traversing the defect, the *transport segment* must correctly interface with and heal to the docking site with a solid, bony union.

BONE TRANSPORT



The regenerate will form in the wake of the transport segment.

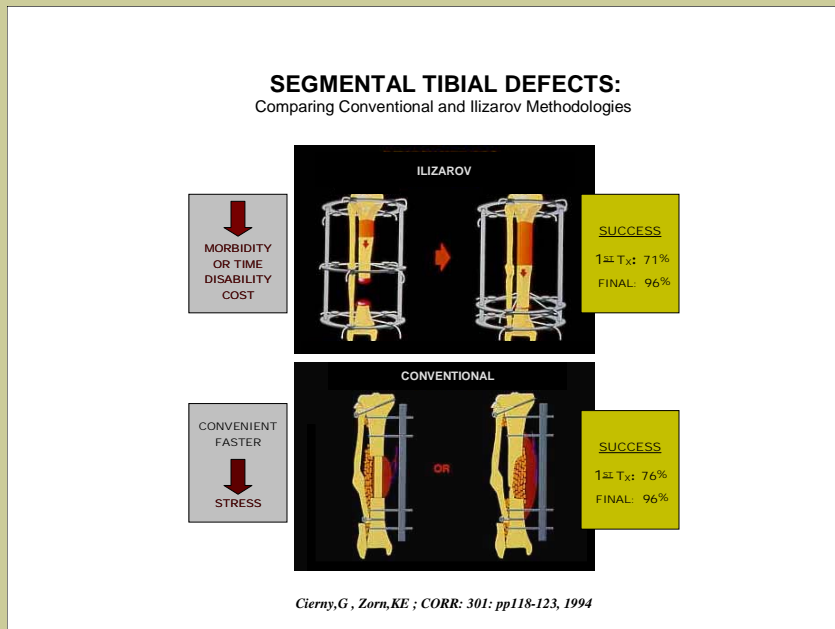
Smoking or using tobacco products during distraction can inhibit regenerate formation and regenerate consolidation in to bone.

BONE DEFECTS

Defects in bone can be due to trauma (i.e.; motor vehicle accident), a birth deformity (congenital defect), a surgical excision for disease (i.e.; infection, *see figure*) or a disease process, itself (i.e.; tumors). These injuries can also lead to an associated loss of the soft tissues such as skin and/or muscle. If such a composite loss exposes the transport segment or docking site, wires can be inserted in such a way as to capture soft tissue for transport with the bone segment. An “open” transport uses distraction methods to simultaneously close a hard and soft tissue defect. Conversely, if the overlying tissues are intact, the bone and wires will simply pass through them.

DOES IT WORK?

Like any other treatment modality, the methods of Ilizarov have a near perfect success record if performed in conjunction with appropriate patient selection, balanced institutional resources and favorable clinical milieu. The figure (below) posts results of the first study to compare these methods with conventional treatment in the anagement of infected non-unions of the tibia with significant bony defects. In the 1st treatment, the tissues were aligned, restored and allowed to heal; in the 2nd treatment, a definitive reconstruction was performed and followed two or more years (final outcome).



IS IT PAINFUL?

The transport segment and its wires exert a slow, constant pressure on anything in their path. Soft tissues respond to this pressure in a natural way, dieing back just enough to allow the objects to pass on through. The process is gentle and constant, very similar to the way our gums will melt away to allow an adult tooth to push up into place. The bone simply pushes through, the wires and pins leave thin, linear scars to mark their passage.

references:

Cierny III,G, Zorn, KE; *Segmental Tibial Defects: Comparing Conventional and Illizarov Methodologies*. Clinical Orthopaedics and Related Research, Number 301, pp. 118-123, April 1994.

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