Distraction osteogenesis is a well-established method in the treatment of bone defects or limb shortening.

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Distraction osteogenesis

Part 1: Unilateral distraction
The use of unilateral external fixation devices for bone lengthening, bone transportation, angular deformities correction, and even arthrodiatasis is simple, allowing the patient to easily understand the instructions for handling.

The unilateral external device has some advantages over circular external devices. It allows surgical debridement, has less compromise to the soft tissues, and is better tolerated by the patient.

Indications
Based on a short learning curve, the use of external fixation has gained ground in handling a variety of diseases, making this technique virtually limitless.

The main applications are:
• Bone lengthening (unifocal or bifocal osteotomies)
• Segment transport
• Deformity correction

Relative contraindications for distraction osteogenesis
There are some cases where the use of external devices has its limits, mainly because of a lack of good consolidation, such as with the following:
• Patients with severe osteoporosis
• Patients with vascular lesions
• Malnutrition and vegetarian eating habits
• Smoking

Complications
Because of the monoplanar application of the pins, skin problems as well as pin track infection is more frequent.

Loss of alignment may occur in cases of long lengthening (eg, femur).

In cases of early removal of the external fixator, to prevent callus deformity or fracture afterwards, the use of an intramedullary nail or plate or brace is indicated.
Case study 1: Osteogenesis distraction unilaterally  
Case contributor: Dankward Höntzsch

Fig 1 Revision osteosynthesis with bone grafting after failed fixation (plate breakage) of open femoral fracture.

Fig 2 Bone necrosis without infection leads to removal of implant and a segment resection (7 cm).

Fig 3 Preoperative planning and application of the distractor.

Fig 4 Finished distraction after 14 weeks (100 days).

Fig 5 Additional stabilization with plates after 20 weeks.

Fig 6 5½ years follow-up after the trauma: removal of condylar plate. Good function and full weight bearing.
Part 2: Ring distraction

Advantages of ring external fixation in the three-dimensional management of traumatic and post-traumatic conditions include the ability to advance to full weight bearing within weeks, thus helping the patient functionally and psychologically; to treat infections with minimal implanted metal; and to correct deformity and bone loss in a gradual, tissue-sensitive manner.

The disadvantages include:
• Transfixation of soft tissue including muscles and tendons
• Difficult approach to soft tissue in cases of reconstructive surgery
• Problematic application with proximal femur and humerus
• Discomfort
• Time consuming and technically demanding application

Instrumentation
Given the wide array of minimally invasive implants currently available, the ring fixator is primarily recommended for cases of bone transport due to bone loss in open fractures or resection for osteomyelitis, and angular deformity corrections and selected periarticular fractures with very small segments. In these cases a ring fixator for a tibial plateau or pilon fracture can change the patient’s condition from wheelchair to weight bearing in a walker.

A minimally invasive, highly modular fixation to correct severe musculoskeletal problems was the goal of the AOTK Ex-Fix working group during the design and testing period. The new design is based on the original concepts with the integration of newer materials providing for a stronger, lighter and more user-friendly frame. The AO ring fixator has been effectively used throughout the world in the past year for fractures, infections, bone transports, lengthening, angular corrections and pediatric cases (Fig 1).

The development of ring fixation into the AO surgeon’s armamentarium makes sense because the principle of biologic fixation is shared by the AO and Ilizarov. The AOTK now seeks to apply its educational principles and methods to the teaching of ring external fixation. In the end, that our patients benefit is what truly matters. Any technique that can help in this task is worth learning.

Fig 1 In this case, a circular frame is used to transport the tibia into 6 cm distal bone defect.

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Case study 2: Distraction osteogenesis with ring fixator

Fig 1 55-year-old male with infected nonunion of the proximal tibia. Hardware removal after secondary surgery with autograft and BMP treatment.

Fig 2 Application of ring distractor after corticotomy and bone resection in the length of 5 cm.

Fig 3 Result 6 weeks postoperatively.

Fig 4 31 weeks after operation and before frame removal.

Fig 5 No pain and no evidence of infection 38 weeks postoperatively. Patient is back to work as a salesman.