

Management of hypertrophic non-union with distraction osteosynthesis by ilizarov

Introduction

Management of hypertrophic non-unions with compression-distraction techniques represents an evident improvement, especially considering the association of non-union with axial deviation or shortening that can be treated simultaneously

In hypertrophic non-unions the tissue interposed between the bone fragments is biologically active and maintains its osteogenic potential and gradual controlled coordinated distraction acts as a strong stimulus towards consolidation; more over if the lack of bone consolidation is associated with axial deviation or shortening, they can be treated at the same time. The concepts of Ilizarov's Law of tension stress is an appropriate mechanical environment by stable osteosynthesis.^{1,2}

Keywords: hypertrophic non-union, distraction osteogenesis, ilizarov

Patients and methods

The technique is simple and consists of providing adequate mechanical conditions to produce distraction osteogenesis. After stable fixation with Ilizarov fixator, gradual distraction is continued at a rate of 1mm per day until the shortening has been corrected. In cases without shortening only periodic distraction is carried out in order to produce and maintain the tension effect during the treatment. If angular deformity or other deformities are associated, treatment is modified in order to correct them. We treated 86 cases between 1995 to 2017. The nonunion at the humerus in 15 cases, femur 25 cases and tibia 46cases. In 26 cases shortening was associated with an angular deformity. Patients were monitored by means of radiographic, ultrasonographic evaluation.¹⁻⁵

Volume 10 Issue 5 - 2018

Bari M M,¹ Shahidul Islam,² Mahfuzer Rahman³

¹Chief Consultant Bari-Ilizarov Orthopaedic Centre, Visiting and Honored Professor of Russian Ilizarov Scientific Centre, Kurgan

²Professor, Bari-Ilizarov Orthopaedic Centre, Bangladesh

³Consultant, Bari-Ilizarov Orthopaedic Centre, Bangladesh

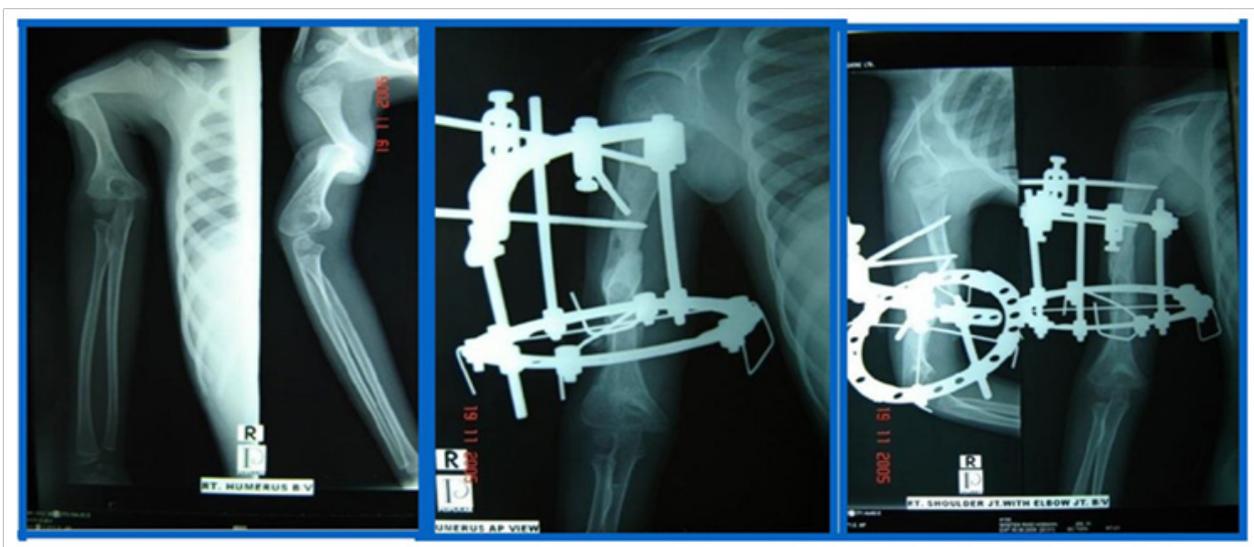
Correspondence: Bari M M, Chief Consultant Bari-Ilizarov Orthopaedic Centre, Visiting and Honored Professor of Russian Ilizarov Scientific Centre, Kurgan, Bangladesh, Email bari.ilizarov31@gmail.com

Received: September 20, 2018 | **Published:** September 21, 2018

Results

The average time of treatment was 6months (range 4-10months). In some patients with femoral non unions knee stiffness was seen during treatment, which gradually restored with the help of kinestherapy after removal of Ilizarov fixator. 10days after the beginning of distraction there is a high proliferation of capillaries that form a vascular net and are filled by red blood cells. After 20days there were fascicules of fibroblasts parallel to the lines of distractional stress.

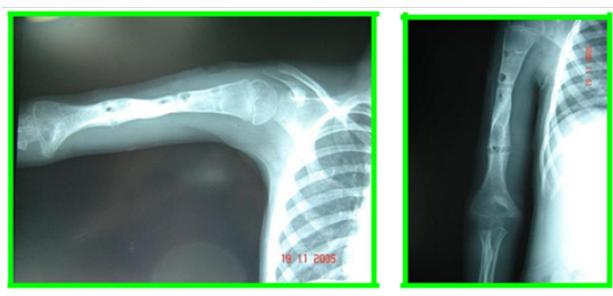
In more advanced phases, there is a gradual differentiation of osteoblasts that starts to form osteoid tissue and then deposits of calcium salts. After 2½ months of distraction the new bone trabecule can be identified.^{1,2,5,6}



Hypertrophic nonunion rt humerus – distraction osteogenesis by Ilizarov



6 yrs old boy



Final follow up after 4months with full consolidation

Discussion

With Ilizarov distraction technique intensive osteogenesis is achieved by means of a gradual controlled coordinated distraction of the fibrous or fibrocartilaginous tissue at the non union site. During the first week of distraction, the central zone of relatively avascular fibrous tissue bridges the 6-7mm gap and that is called fibrous interzone(FIZ). At this time spindles shaped cells (which resemble fibroblast) are loosely interposed between collagen bundles, osteoid and osteoblast are not present. Von Kossa staining and Back scattered scanning electron microscopy of non decalcified specimens confirm the absence of bone minerals.^{1,2} By the 2nd week of distraction clusters of osteoblasts appear on each side of the FIZ adjacent to the vascular sinuses and collagen bundles fuse with an osteoid like matrix. In the 2nd week osteoid begins to mineralize, these bone specules are known as Primary Mineralization Front (PMF). They extend from each hypertrophic surface towards the central FIZ like stalegmites and stalegites. After the 3rd week, the FIZ undulates across the centre of the distraction gap with an average thickness of 6mm. the act very similarly to the “interzone” located between the two ends of a corticotomy where bone lengthening is performed. The functional features of this kind of nonunion (hypertrophic & hypervascularity) are the main characteristics. The results obtained in our series confirm that in hypertrophic nonunion of long bones the consolidation can be achieved by simple gradual distraction (maintaining a tension effect) with simultaneous correction of shortening and of other deformities if present. Therefore distraction osteosynthesis is a powerful stimulus towards bone consolidation. The morphologic study confirms the intensive stimulus to neoangiogenesis and the absence of a

cartilaginous stage between the initial tissue and the new bone. And so the process can be considered as a membranous ossification. The mineralization process continues and a bridge is formed by the elongation of new bone specules. The tips of the specules begin at a diameter of 7-10microns and expand to 150 microns near the distraction surface. At the end of distraction, the FIZ ossifies and the MCF unifies completely bridging the gap. Normal appearing marrow elements replace the fibrovascular tissue which fill the spaces around the bone columns.¹⁻³ Distraction osteogenesis has been referred to as a growth plate and in the sense of bone regeneration, it is. Histologically, it is intra membranous ossification in its purest form. Studies show that blood flow peaks at 7times normal during the 1st 4weeks of distraction and then decreases but remains elevated, a 3x times normal for the next 3months.⁴ The histology and physiology of a hypertrophic non-union is very similar to distraction osteogenesis. In that both have well vascularized, live bone ends that are connected by a stiff fibro cartilage interface. Therefore primary distraction of a hypertrophic nonunion using the Ilizarov method stimulates renewed osteogenesis.^{6,7}

Conclusion

In hypertrophic non unions of long bones, only proper gradual controlled coordinated distraction can give an excellent bone formation and achieve good consolidation, associated with shortening and angulation correction. In these instances distraction are applied gradually at the standard rate and rhythm to achieve optimum biological function.

Acknowledgements

None.

Conflict of interest

Author declares that there is no conflict of interest.

References

1. Aronson J. Symposium- biological & clinical evaluation of distraction histogenesis. *Clin Orthop*. 1994;301:2-163.
2. Aronson J. *Biology of distraction osteogenesis*. In: Bianchi- Maiocchi A, Aronson J, editors. *Operative Principles of Ilizarov*, Baltimore. Baltimore: Williams and Wilkins; 1991:42-52.
3. Aronson J, Good B, Stewart CL, et al. Preliminary studies of mineralization during distraction osteogenesis. *Clin Orthop*. 1990;250:43-49.
4. Aronson J, Harp JH, Walker CW. Blood flow, bone formation, and mineralization during distraction osteogenesis. *Trans orthop Res SOC*. 1990;15:589.
5. Villa A, Catagni M. *Non-union principles of treatment*. In: Bianchi- Maiocchi A, Aronson J, editors. *Operative principles of Ilizarov* Williams and Wilkins: Baltimore; 1991:89-98.
6. Ilizarov GA. Clinical application of tension stress effect for limb lengthening. *Clin Orthop Relat Res*. 1990;250:8-23.
7. Paley D. Problems, obstacles and complications of limb lengthening by Ilizarov Technique. *Clin Orthop Relat Res*. 1990;250:81-104.
8. Bari M M. *A color atlas of limb lengthening, surgical reconstruction and deformity correction by Ilizarov technique*. Bari-Ilizarov Orthopaedic Center; 2013.