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Incidence of complications in Ilizarov ring fixator in tibial lengthening

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Abstract
Prof. llizarov was awarded the Lenin prize for medicine in 1978 and International recognition came to him in the 19803, when his work came to be known in Europe, More recently the work came to be known in other countries like USA and Canada. The present status of the affected limb was assessed in terms of length, status of various deformities and function of the muscle and joint and vascularity the limb. General Assessment of the patient profile was done. This was mandatory and its findings were co-related with the clinical observation. Based on this deformity were found and treatment given accordingly. Moreover, this served as a baseline reference for the prospective treatment. Out of the total 28 cases there were 15 excellent 10 cases were good, and 2 cases were fair and 1 case poor results, depending upon the lengthening index, deformity correction, gait, weight bearing and joint and muscle function were analysed.

Keywords: Complications, ilizarov ring fixator, tibial lengthening

Introduction
Many techniques were devised for limb lengthening since the advent of [2]0th century. Acute limb lengthening as first performed by Codivilla in 1895 by a sudden and strong pull on an oscalcis pin after oblique femoral osteotomy, Steinmann pin as used first to produce traction on the tibia. Slow distraction using pins above and below was developed by Putti, Later Steinmann pin was replaced by K wire. In 1930 corti cotomy over ostetomy was used for lengthening in 1930 Wagner lengthening apparatus was introduced. It was uniplanar fixator achieved by Schanz screws connected by monolateral tubular lengthening device achieved by a mid disphyseal corticotomy. Later Prof. llizarov devised a circular external fixator using the theory of distraction osteogenesis. The certain case toward, the end of bone lengthening, grafting and plating was done to produce consolidation. The illiteracy of the people and poverty led to disrepute to this system [1].
Dr Gavriil Abramovich llizarov (1921-1992) was born in an economically backward Jewish community of the USSR. Due to dire poverty he had a difficult schooling and medical education. After graduation he was sent by the Government to work in the village of Dolgovoka in the Kurgon district of western Siberia. In 1950 he developed a versatile ring fixator. He worked wonders using the theory of distraction osteogenesis. He struggled to gain recognition among the senior professors even after demonstrating his results: but he was called as the ‘Magician from Kurgen’ by the patient.
With his successful method of treatment, he showed that the controlled distraction of the bone stimulates osteogenesis. For all the achievements recognition in his own country came late. An Olympic athlete Valery Brumal was treated successfully by Prof. llizarov with his ring fixator. His fame was carried overseas by another patient, an Italian explorer by name Mauri. [2]
He was a guest of honour in many an international conference. He became the Director of VKNC-UTO Russia a sprawling Institute dedicated for research work and treatment based on llizarov Principles, Asami (Association for study and application of methods of llizarov) was constituted with overwhelming international membership [3].
Dr Paley Catagni, Cattaneo, Maocchi, are among his famous disciplines. Prof. llizarov passed away in 1992 at the age of 71 giving the whole world and the suffering millions a new way of hope and new dimensions and directions in treatment [4].

Methodology

The study was conducted in orthopaedic department, Medical College Hospital. Around 28 cases were treated by the Ilizarov ring fixator. Of the 28 cases, 17 cases were with gross bone loss following RTA. 2 cases were shortening following PPRP- 2 case due to Perthes disease and 2 cases due to congenital cause and 5 due to osteomyelitis

H/o: A detailed history was taken, including the bio-data cause of the deformity and the treatment undergone.

The present status of the affected limb was assessed in terms of length, status of various deformities and function of the muscle and joint and vascularity the limb. General Assessment of the patient profile was done.

This was mandatory and its findings were co-related with the clinical observation. Based on this deformity were found and treatment given accordingly. Moreover, this served as a baseline reference for the prospective treatment.

Results

Age Incidence

Age of the patient varied from 7 to 50 years with a mean incidence in its 3rd decade as illustrated in the bar graph.

Sex Incidence

Male preponderance - 24 males and 4 were females

Cause of deformity

Majority of cases were those associated with bone loss which leads to non-union.

Indication for Procedure

It was functional in	21 cases
Cosmetic in	7 cases

Pin tract infection and pain during distraction were universal

Table 1: Complications

Complications	Patient	%
Ring Sequestrum	6	21.43
Axial deviation	3	10.71
Facture	1	3.57
Apparatus instability	2	7.15
Nerve injuries	1	3.57
Behavioural abnormality	9	31.15
Arterial damage	0	
Metal reaction	3	10.71
Refracture	3	10.71

Out of the total 28 cases there were 15 excellent 10 cases were good, and 2 cases were fair and 1 case poor results, depending upon the lengthening index, deformity correction, gait, weight bearing and joint and muscle function were analysed.

Discussion

While the apparatus in being applied to the leg. It is supported by a specially made stand. The rotational alignment of the leg is maintained by a Calcaneal traction or manually by one of the surgeons, as mentioned earlier 1.8mm wires are used. To avoid injury to neuro vascular structures they are inserted in the safe zones of the leg as seen in the Topographic Atlas, showing the cross sections of leg at various levels.

The wires are inserted from the side with the vital structures e.g.: lateral surfaces of the leg. They are pushed normally up to the bone and then drilled through both cortices, power drills are best avoided to reduce heat necrosis of bone and late loosening of wires. After piercing the distal cortex the wire is hammered out to avoid injury to vital structures by a rotating wire that may entangle them.

The muscles have to be stretched to the maximum of all the joints before wire insertion e.g.: The Ankle joint is dorsiflexed before positioning the wire posteriorly and vice versa when the wire is passed anteriorly.

The skin must rest without stretching during lengthening extra skin may be pulled into the area to prevent late sketching of skin.

The ring should be 2 to 3 cm clear of the. Limb all around to accommodate for any post-operative oedema. But the smallest possible ring should be Chosen to increase the stability of the construct. There should be at least two levels of fixation per fragment either with two rings or by adding a drop wire to the ring. The wires are never forced to the ring. If they are offset, they are fixed with washers or posts to the rings or they should be reinserted to a better position on the ring. This method may cause wire loosening in the long run because of two adjacent holes of the bone. The opposing wires should pass through either side of the ring to that the deflection of 5mm (thickness of the ring) will produce additional stability to the construct. The rings of each fragment should be perpendicular to that particular fragment and not to the axis of the limb as a whole. The limb, as a whole should be in the centre of the ring, not the bone. The use of slotted or cannulated wire fixation bolts depend on the position of wire over the hole in the ring [5].

The threaded rods must be parallel and equidistant to each other on the circumference of the ring: Usually four rods are used between the adjacent rings. Use of telescopic rods increase the stability.

In the past, surgeons performing limb lengthening have observed spontaneous new bone formation in the widening distraction. Professor llizarov since 1951 was engaged in clinical, biological engineering and basic science research that has led to the discovery of the law of “Tension stress”. Gradual traction on living tissue creates, stresses that can stimulate and maintain the regeneration and active growth of certain structures. The regeneration is characterised by the stimulation of both proliferative and biosynthetic cellular functions and depends upon adequate blood supply and the stimulus of weight bearing [6]. Mechanical forces can produce two separate biological processes.

Distraction Osteogenesis

It is Denovo production of new bone by induction between bony surfaces that are gradually puIled apart. The biological bridge between these bony surfaces arises from local neovascularisation and span the entire cross section of the cut surface. During distraction a fibrovascular interface is aligned parallel to the direction of distraction which new bone columns add length to the gap. When biological and mechanical condition during distraction are ideal bone is formed by pure intra membra neous ossification

Transformation Osteogenesis

It is the mechanical stimulator of a pathological bony interface to regenerate normal bone continuity. Depending on the stability and composition of pathological interface, variation in compression and distraction induce osteogenesis [7]. When a distraction force is applied between a bony interface the forces are equally distributed through-out the tissue between the sectioned fragments. The distraction force is always stronger at the borders which is called as advance front, gradually grows weaker towards the centre. At the centre of the tissue where the forces oppose each other the two forces tend to cancel each other and a critical quiet zone is formed. It is in this zone of NeuraI forces that the first sign of Osteogenesis is initiated. As this osteogenesis continues this will resemble a special growth plate created within the elongated bone. As soon as the distraction ceases the osteogenesis area invades the entire tissue rapidly. Five distraction zones have been defined within the site of distraction osteogenesis by quantitative complete tomography.

This is a central radiolucent zone persisting throughout the distraction. This zone is formed by parallel bundle of a vascular dense fibrous tissue resembling tendon. This is called the ‘Pseudo growth plate”

Immediately adjacent to the radiolucent zone is transitional zone known as primary mineralisation front. This zone is formed by large vascular spaces with immature endothelial cells suggestive of capillary collection. This zone also contains spindle cells oriented longitudinally with matrix showing early calcification. The histology of this region resembles that of Sharpey's fibres. This is the zone of vascularisation and early calcification and is seen on both sides of the central fibrous inter zone [8]. Just proximal and distal to the transitional zone, this is the baseline zone formed by distinct bone columns diameter separated by fibrovascular spaces of equal diameter. These columns slowly increase in size, by opposition of new collagen bundles, Mineralisation occur intimately within the poles between collagen bundles. Histology of this sequence resembles intra membranous ossification.

By the day 14th of distraction new bone is first seen forming at two ends arising from the entire cross section including spongiosa, cortex and periosteum. On the 21 St Day of distraction the new bone has differentiated into micro columns with a maximum diameter of 200 microns. The central region of the osteo genic area remains as fibrous inter zone containing trace amounts of calcium and no crystallised hydroxy apatite. The fibrous inter zone persist throughout the distraction averaging three or four milli meters in length. It follows on undulating course parallel to the margin of the bone ends.

Following distraction, the bone columns bridge across to fibrous inter zone and by post-operative 77th day the osteogenic area has remodelled radio graphically demonstrated early cortex formation. By post-operative day of 119th day the oseogenic area contains lamellar bone and Harversion system and Hematopoietic marrow. The histology is indistinguishable from the host bone with normal cortex, trabecular bone and bone marrow elements. The linear rate of the osteogenesis is calculated as over 200 microns per day.

Conclusion

- Commonest site is tibia, followed by femur
- The most common age group is 3'd decade
- The most important indication is gross bone loss.

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