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A study on application of Ilizarov ring fixator in Tibial lengthening

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Abstract
For tibia four rings configuration was optimal inadequately tensioned intraosseous wires also created instability predisposing to non-union. Excessive rate of lengthening resulted in stretching and thrombosis of the newly formed tissues. Lengthening less than one milli meter per day resulted in precocious consolidation of the new bone. 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. The duration of treatment seem to be longer compared to other treatment modalities. This depends up on the length of the bone to be achieved. The bone grows by about 1 mm/day in unifocal corticotomy. If bifocal corticotomy is performed, more length is achieved.

Keywords: Ilizarov Ring Fixator, Tibial Lengthening, corticotomy

1. Introduction
Short stature lead to psychological stunting of the poor victims. The omnipresent cosmetically unacceptable deformities be it congenital or acquired is a constant source of worry. So, in 1950 Prof. G. llizarov from Kurgon is Siberia devised a versatile circular external fixator for treatment by limb lengthening and for other deformity correction. He worked wonders using the theory of distraction osteogenesis, which ran contrary to the prevalent trends of orthopaedics.

In man however regeneration of tissue can be accepted to a limited extent. The most highly differentiated tissues have a naturally lesser ability to regenerate and those that are with relatively less differentiation, such as connective tissue have far greater capacity for regeneration [1].

The primary motivator for tissue regeneration and reproduction is the important process of inflammation. This is defined as the focal reaction of living tissue to physical, chemical or immunore active agent (e.g.: bacteria, viruses). This inflammation (phagocytosis neo vascularisation mesenchymal infiltration) is thought to be controlled by neurohumoral factors which results in subsequent tissue regeneration. In terms of llizarov technique, the phase of fibrovascular repair is of primary importance. In the course of lengthening a tubular bone, for example osteotomy through a subcutaneous approach limited to the cortical bone (corticotomy) leads to a histologically active site [2]

Local undifferentiated mesenchymal cell evolves into osseoblasts producing/ collagen, osteoid matrix and then bone mineral.

Through the application of distraction force this osteogenesis is formed longitudinally is in the direction of the line of force. The newly formed lamellae are arranged parallel histologically in the regenerate bone which is visible on X ray.

The biology of growth according to llizarov is maintained within the tissue. In internal distraction there will be endochondral proliferation stretching periosteum, vessels, nerves, muscle, skin to induced bone growth [3].

At the conclusion of growth, the genetic plan designate that the cells have occupied all the space genetically destined for them and growth ceases. The bone growth depends upon the ability to regenerate tensile force with in the limb. Distraction of corticotomy by mechanically

applied external tension force called "distraction osteogenesis" is the primary method of limb lengthening.

The second method is epiphysiolysis or Epiphyseal distraction. This is applied without corticotomy when physis is well formed. This is Salter and Harris type I physeal separation through the area of hypertrophic cartilage. This may lead to growth arrest. At the end of lengthening the regenerated bone undergoes a maturation phase until the new bone is morphologically and functionally in distinct from normal bone [4]

In limb lengthening one milli meter per day is the critical rate and 0.2mm every six hours the critical rhythm. The 1 mm lengthening is achieved without interruption of the function of the limb. Doubling the rate of distraction requires two corticotomy sites, proximal and distal. There is tendency of developing musculo-tendinous contractures leading to joint stiffness with potential paraesthesia due to stretching of peripheral nerves & rarely traction injury to vessels resulting in ischaemia. These complications do not occur if the patient maintain normal activity during the procedures. Once the correction of all deformation and lengthening has been completed, the apparatus is fixed and left in place in order to allow the bone to mature and to avoid collapse of regenerate bone [5]

The progression of histogenesis is controlled by mechanical factors (stability at the site of the bony separation and so called rhythm of the distraction, and biological factors, local osteogenic potential and vascularity of the bone.

For tibia four rings configuration was optimal Inadequately tensioned intraosseous wires also created instability predisposing to non-union. Excessive rate of lengthening resulted in stretching and thrombosis of the newly formed tissues. Lengthening less than one milli meter per day resulted in precocious consolidation of the new bone.

The site best suited for a corticotomy is the metaphysis of the long bone which is highly vascular, the muItipIe collateral vessels are less likely to be cut. This area is rich in haemopoietic cells, and active in remodelling which is important for osteogenesis. This osteogenesis manifests itself after harmonious equilibrium is established between biological and mechanical factors.

Tibia is one of the long bones which is more prone for injury and congenital deformities which many leads to shortening. They are eventually treated with the Ilizarov frame. The study aims to evaluate the rise of Ilizarov fixator as method of treatment in tibial bone lengthening, in congenital shortening or lengthening or acquired lengthening or shortening and there by improving the final clinical and functional outcome.

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

Clinical Examination

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

Radiological examination

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.

Treatment Planning

Each case has its own. individual treatment plan. Clinical and radiological assessment helped in planning the treatment strategy.

Operative Technique

Based on Ilizarov principles various forms of assembly as per requirement of the case After an initial 2 week hospital stay more patients were treated on an outpatient basis with weekly or monthly follow up.

Follow up

This consisted of clinical and radiological assessment. Apparatus removal was done after clinical and radiological judgement based on existing principle of regenerate maturation.

Results

Table 1: Distribution based on causes

Causes	Number of patients
Gap non union	17
PPRP	2
Congenital deformity	2
Infection	5
Perthes disease	2
Total	28

Table 2: Patient awareness on ring fixator

Source of information	Number of patients
Newspaper	20 (71.42%)
Our suggestions	4 (14.29%)
Other methods	4 (14.29%)
Total	28 (100%)

Duration of treatment

The duration of treatment seem to be longer compared to other treatment modalities. This depends up on the length of the bone to be achieved. The bone grows by about 1 mm/day in unifocal corticotomy. If bifocal corticotomy is performed, more length is achieved.

Table 3: Duration

Months	Number of cases
4 - 6	4
6 – 9	7
9 - 10	11
10 – 12	4
12	2

Average lengthening

The lengthening index varied depending upon the indication while it approached ideal value in cosmetic lengthening. It was observed that mean value was 0.85. Moreover, lengthening of around 120m was achieved in gross bone loss.

Discussion

The patient selection plays a crucial role in the outcome of fracture since the treatment schedule is prolonged and required patient compliance, the patient profile should be

assessed meticulously. He or she should be motivated, co-operative, and patient enough and be of average intelligence to understand the procedure and carry out distraction correctly. In cosmetic indications pre-operative psychological assessment is indicated.

It is a very costly treatment, but since it is highly effective it should be an essential component of any orthopaedician' s armamentarium [6]. Thorough clinical and radiological assessment and a preassembly are essential to avoid confusion and wastage of time on the operating table.

It is ideal to use fracture table for the lower limb. The preassembled frame save time. An atlas showing the safe zones for transosseous wire insertion should be exhibited prominently in the operating room [7].

Uses of power drill may give rise to ring sequestrum because of heat necrosis. Dynamometric wire tensioning is preferred to manual tensioning as the latter can give rise to unequal tensioning resulting in apparatus Instability [8]. Any compromises in the construct of a frame may lead to later instability Too heavy frame may lead to lack of patient co-operation injection can be given in difficult cases or with a view to decrease the treatment duration.

The greater number of cases are done, the greater the number of complications seen. The technique requires a reasonable amount of skill and imagination and has therefore a steep learning curve. The complication has already been mentioned. Pain and pin tract infection are the most important. Nerve palsies are usually transient and regressive with antibiotics and removal of that particular wire. Vascular injury may necessitate an open repair following in arteriogram. Axial deviation resulting from lengthening is a common occurrence. Refracture due to early frame removal has been observed. Metal reactions, particularly at the time of locking of apparatus even though rare can be seen. But the complications of failure are a rare occurrence.

Apparatus should be removed only after complete maturity of the regenerate has occurred. Unwarranted enthusiasm for removal may be catastrophic.

Cosmetic lengthening was assessed by the lengthening index which is the lengthening obtained divided by the total numbers of days. A lengthening index of 1 &1.25 is considered ideal. Other factors like improvement of gait,correction of deformity, weight bearing, joint and muscle function, cosmetic and radiological status were factors taking into account for grading of other cases.

In the final analysis the ring fixator have proved to be m escape route for long standing problems. Its costs and duration of treatment, has emerged as an effective treatment for limb lengthening for functional improvement and also, for cosmetic purpose.

Conclusion

- Neurovascular damage should be prevented
- Removal of the fixator is crucial better delay than hurry.
- Cost and duration of treatment has to be borne in mind.
- Average duration is around 8 months.
- The mean lengthening index over 0.85
- Analysis revealed excelled result in 15 patients good in 10 patient

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