

# Management of Pseudarthrosis Tibia by Physeal Distraction with Ilizarov Ring Fixator

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## ABSTRACT

**OBJECTIVE:** To observe the results of chondrodiastasis / physeal distraction in the management of pseudarthrosis of tibia by Ilizarov ring fixator.

**PATIENTS AND METHODS:** Nine patients, seven males and two females, with congenital pseudarthrosis of tibia were treated from February 2008 to April 2012. The age at the onset of Ilizarov treatment was 10 to 12 years. Meticulous & complete resection of the sclerotic bone ends & surrounding fibrous hamartoma, and reopening of the medullary canals was done. Two navigation wires were passed through both the malleoli. Generous autogenous bone graft was placed, harvested from the ipsilateral iliac crest. Advanced hybrid Ilizarov ring fixator was applied. Acute compression at the pseudarthrosis site was done. One ring was applied in the proximal tibial epiphysis. Fracture was done at proximal physeal plate by rotatory movements. Fibula attached proximally and distally to proximal and distal rings.

Distraction was started on the 5<sup>th</sup> day at the rate of 0.5 mm/24 hours for 10 days. Later on distraction rate was accelerated to 1mm/day with a rhythm of 0.25 mm/6 hourly. Ankle deformities were addressed accordingly.

**RESULTS:** Union was achieved in all the nine cases at the time of frame removal. All the other associated deformities were addressed simultaneously while the frame was on. Leg length discrepancy was addressed by physeal distraction. Growth was not arrested in all cases after physeal distraction.

**CONCLUSION:** Ilizarov ring fixator remains the treatment of choice to achieve refracture free union till 4 years in congenital pseudarthrosis of tibia, one of the most perplexing and challenging orthopedic problems. And there is no physeal arrest after physeal distraction to treat leg length discrepancy.

**KEY WORDS:** Congenital pseudarthrosis of tibia, physeal distraction, Ilizarov ring fixator.

## INTRODUCTION

The Congenital pseudarthrosis of tibia (CPT) is a particular type of the non-union that is present at birth or infancy. Congenital pseudoarthrosis is usually present in distal half of the tibia and fibula and often the same extremity. (Figure 1)

The aetiology and pathogenesis remain unclear<sup>1,2,3,4</sup>, but often in patients with neurofibromatosis, or associated stigma<sup>5,6</sup>. Electron microscopy and histological examination of the tissue shows that primary pathology of CPT is the formation of the dense connective tissue with hyperplasia of fibroblasts.

This aggressive fibromatosis is present at tibial periosteum and around the tips of broken bones and causes compression, bone resorption and persistence of pseudarthrosis<sup>3,7,8</sup>.

Paley<sup>9</sup> postulated that main pathology is in periosteum instead of bone. This assumption was defended anatomically & physiologically by the tough hamartomatous transformation of periosteum resulting in choking of bone leading to atrophic appearance & resulting in avascular ends. Posteriolateral muscle mass of the

leg causes anterolateral bending of tibia.

Histopathological examination of Hermanns - a Sachweb et al.,<sup>10</sup> seconds Paley's assumption that periosteum is the main culprit. Their observation was that tough sheath of neural cells was present around the periosteal arteries, in the same way Schwann cells of periosteum cause choking of periosteal blood supply. Periosteal hypoxia creates thick fibrous band depriving the nutrients to sub periosteal bone leading to atrophic bone ends.

CPT is still one of the most painful and difficult orthopedic problems.

Initially union in CPT has been achieved at large after use of Ilizarov ring fixator<sup>9,11</sup> and intra medullary nails<sup>12</sup>. But complications most often occur and endanger the functional outcome. These could be LLD (leg length discrepancy), multi level & multi directional deformity, foot deformity, ankle valgus deformity and concomitant fibular pseudarthrosis.<sup>11,13</sup> Most critical complication is re-fracture and may reinstate pseudarthrosis. Nevertheless, existing treatment modalities do not forbid re-fracture altogether<sup>9,20</sup>. This situation

most often lands up with disappointed family and child who has undergone several failed operations and an extremity that is short, distorted & has almost no function. This situation propel some surgeons to recommend amputation if the third operation could not attain bony union and a functional extremity<sup>13,21</sup>.

Physeal distraction stands for epiphyseal distraction in the literature. Anatomically the appropriate name should be physeal distraction. By application of pins on both sides of the growth plate connected with an external distraction device, physeolysis, according to Monticelli & Spinelli<sup>22</sup> and gradual lengthening without physeolysis, chondrodiastasis, according to De Bastiani et al.,<sup>23</sup> with new bone formation can be achieved. Hahnel<sup>24</sup> says that this procedure has already being done by Ilizarov in 1954. Bjerkreim<sup>25</sup> and de Pablos and Canadell<sup>26</sup> observed disturbance of growth in the distracted physis. Whereas, Zarzycki et al.,<sup>27</sup> did not notice any premature growth cartilage closure after physeal distraction in 40 patients, however stunted growth potential can be anticipated.

The purpose of this study was to observe the results of chondrodiastasis / physeal distraction in the management of pseudarthrosis of tibia by Ilizarov ring fixator.

#### PATIENTS & METHODS

In this study, there were nine patients of pseudarthrosis of tibia with a minimum follow up of 4 years since removal of frame. Using single evaluation protocol, the relevant clinical & radiological information was evaluated.

Seven of the nine patients were males. Six patients had been previously operated on for one or more times. The age at the onset of Ilizarov treatment was 10-12 years. Five of the patients had associated neurofibromatosis.

A single surgeon performed all operations. The procedure consisted of meticulous & complete resection of the sclerotic bone ends & surrounding fibrous hamartoma, and re-opening of the medullary canals. (Figure II). Two navigation wires were passed through the malleoli. Generous autogenous bone graft was an essential part of the operation, harvested from the iliac crest. Advanced hybrid Ilizarov ring fixator was applied, two rings in each segment i.e., two point fixation. Acute compression at the pseudarthrosis site was done. One ring was applied in the proximal tibial epiphysis. Fibula attached proximally and distally to proximal and distal rings.

Fracture was created at physeal plate by rotatory movements. Distraction was started on the 5<sup>th</sup> day at the rate of 0.5 mm/24 hours for 10 days. (Figure.III). Later on distraction rate was accelerated to 1mm/day with a rhythm of 0.25 mm/6 hourly. Ankle deformities

were addressed accordingly.

Frame was removed after maturation of regenerate. Slab support was given for two weeks.

Ankle foot orthosis (AFO) with anterior shield was recommended till skeletal maturity.

Data were analyzed in statistical program SPSS version 16.0. Simple frequencies and percentages were calculated.

Age	No. of previous surgeries	Follow up
10 YEARS	01	4 YRS 2 MONTHS
12 YEARS	02	4 YRS 0 MONTHS
11 YEARS	01	3 YRS 8 MONTHS
10 YEARS	00	3YRS 3 MONTHS
11 YEARS	01	3YRS 0 MONTHS
11 YEARS	02	3 YRS 0 MONTHS
10 YEARS	01	2 YRS 8 MONTHS
10 YEARS	00	2 YRS 5 MONTHS

#### RESULTS

The age at the onset of Ilizarov treatment was 10-12 years.

Bony union was achieved at docking site in all cases at the time of frame removal. (Fig.4) Bony union is defined as restoration of cortical integrity, confirmed by x-rays. Length gained was 10-12 cm by Physeal distraction with no leg length discrepancy and no residual ankle deformity in all cases. In one case regenerate was weak as the patient's attendant did not follow the rate of distraction. So distraction rate was slowed down. Later on regenerate get consolidated.

All the other associated deformities e.g., leg length discrepancy, tibial deformity, ankle mortise valgus, ankle joint dorsiflexion and valgus contracture were addressed simultaneously while the frame was on.

Leg length discrepancy was addressed by physeal distraction. Length gained was 10-12 cm. The mean treatment time was 13 months ranging from 12-16 months. Follow up time ranged from 12 months to 48 months. Type 1 pin tract infection was noticed in all the cases.

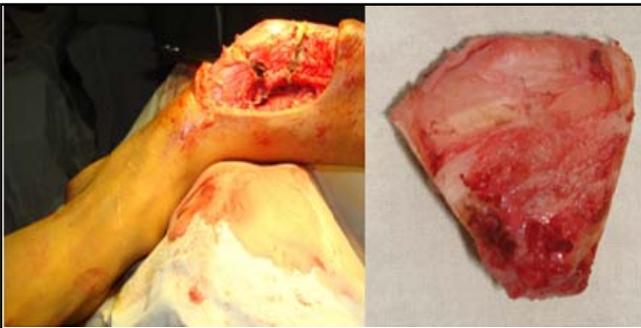
Growth was not arrested in all 9 cases after physeal distraction.

This study concludes that Ilizarov ring fixator is an excellent tool to achieve union in congenital pseudarthrosis of tibia. The union achieved is fracture free upto four years after removal of fixator, and there is no physeal arrest after physeal distraction performed to treat leg length discrepancy.

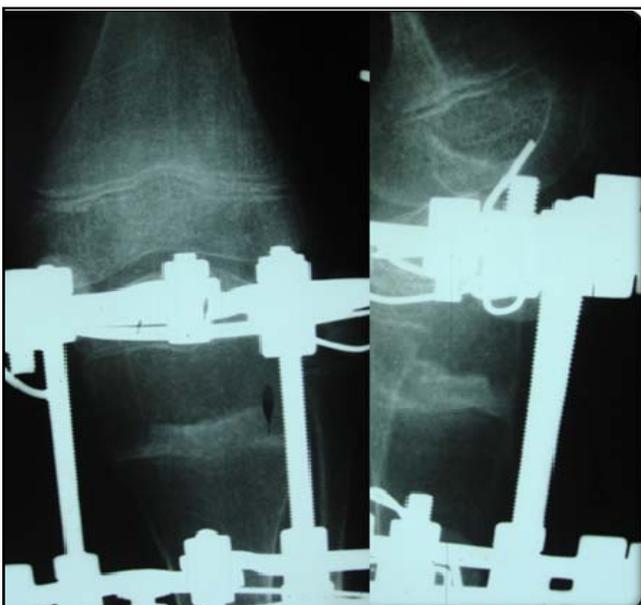
**FIGURE I: PRE-OPERATIVE X-RAYS**



**FIGURE II: PER-OPERATIVE PHOTOGRAPHS**



**FIGURE III: X-RAYS WITH PHYSEAL DISTRACTION**



**FIGURE IV: FINAL X-RAYS**



## DISCUSSION

Over the years many operation have been performed to achieve union in the pseudarthrosis of tibia but the results are not encouraging<sup>28</sup>.

The reported procedures e.g., onlaygraft has only 12.5% union rate, by pass procedure 7%, Sofield procedure 25%, sliding grafts 35%, bone allograft 17%, autogenous bone grafts 10%, Farmer procedure<sup>29</sup> (composite skin & bone pedicle from the other leg) has union rate of 53%. With Ilizarov technique it was possible to obtain union of pseudarthrosis in every patient. The reported refracture rate was 68% when only the Ilizarov ring fixator was used, whereas this rate was reduced to 29% when the IM rod was combined with the Ilizarov ring fixator.<sup>30</sup>

Vascularized fibular grafts filled the resection gap very well but resulted in nonunion or delayed union at one end.<sup>31</sup>

Angular deformities were corrected but leg length discrepancies were not addressed and residual ankle deformities were not dealt with.

In our series, although number of cases was limited, the union was achieved in all cases after resection of

diseased bone along with periosteum and autogenous bone graft. Leg length discrepancy was dealt with physeal distraction. In this procedure the regenerate is very good. There is no growth arrest but reduced growth potential cannot be excluded. Residual ankle deformities were addressed while the frame was on. In four years follow up no refracture is reported. The patients are using AFO with anterior shield.

### CONCLUSION

The observations performed allowed to conclude that the Ilizarov ring fixator with resection of diseased bone, autogenous bone graft & physeal distraction addresses the disease and deformities associated with pseudarthrosis of tibia very well and there is no growth arrest after physeal distraction but reduced growth potential cannot be excluded. In this series, as number of cases was small, more research is recommended to address the subject in better way.

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