Case Report International Journal of Paediatric Orthopaedics | Jan-April 2020 ;6(1): 20-23

Correction of coronal, rotational deformity and shortening in a paediatric femur using Ilizarov technique – A case report

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Abstract

Background: Deformities in femur in children usually involves more than one axis with angular as well as displacement components. Moreover, the remaining growth in the opposite limb necessitates adequate lengthening of the ipsilateral limb.

Case Details: A 9 year old female child presented with genu varum deformity and shortening of 8 cm. X ray revealed the deformity to be localized to distal femur. CT (computed tomography) showed physeal bar in the medial half of distal femoral physis. We performed corrective osteotomy just proximal to the CORA (center of rotation of angulation) and corrected the deformity using Ilizarov apparatus, following which lengthening was done using same apparatus.

Results: A lengthening of 10 cm (over lengthening) was achieved with a lengthening index of 1.4 cm/month. Varus deformity was slightly over corrected to 5 degree of valgus. The range of motion of knee two months after fixator removal was 20 degree. One major complication in the form of regenerate fracture was encountered when the fixator was insitu. This was managed by reapplication of the pins. We achieved correction of varus, internal rotation, and shortening in the right femur.

Conclusion: Multiplanar deformities in children need prolonged treatment after corrective osteotomy. Ilizarov fixator provides the required mechanical stability as well as versatility to achieve this goal. Prolonged physiotherapy is necessary to restore the range of motion after fixator removal.

Key words: Multiplanar deformity, Ilizarov, osteotomy, lengthening, Paediatric femur

MeSH terms: Femur, rotation, Osteotomy, Genu varum, Bone lengthening

Introduction

Deformities in femur can occur in any of the six axis. If it occurs in more than one axis, the correction of such a deformity requires expertise of surgeon. Traditional limb lengthening techniques, introduced by Codivilla, modified by Anderson and popularized by Wagner, have been associated with high rates of complications [1]. Additionally, these methods did not address deformities of angulation, translation or rotation that occurred simultaneously in a given limb segment. In 1972 Ilizarov published his remarkable experience with femoral lengthening at a significantly lower complication rate [2]. The femoral deformity may be due to congenital reasons, post traumatic sequelae, post infective sequelae, developmental dysplasias, or metabolic disorders. We are presenting a case of physeal arrest involving distal femur, and its corrections in three axes using Ilizarov apparatus.

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Case Report

A 9 year old female child was brought with complaints of bowing of the right knee and shortening of the right lower limb. At the age of 4 years, her parents observed a limp in the right lower limb, followed by gradual bowing of knee. At the age of 5 years, physeal bar (Fig. 1) in the medial femoral condyle was excised. At the age of 9 years, she presented with genu varum and shortening of 8 cm (Fig. 2). X ray revealed varus deformity in the distal femur, with mechanical axis deviation of 30mm (Fig. 3). The center of rotation of angulation [CORA] was found to be at the level of metaphysis [angle = 25 degree] (Fig. 4).

We planned for deformity correction using ilizarov apparatus, followed by lengthening using same apparatus. Since the apex of deformity was juxta articular, we performed an osteotomy just proximal to the CORA [osteotomy rule 2]. We distracted at a rate of 1mm per day [using rule of equal triangles] to correct the angulation. Once the angulation was corrected, limb lengthening was initiated at the rate of 1mm per day. At the end of 5 months, the child fell down from the cot leading to the fracture of the regenerate (Fig.5). [At this point, we noted an internal rotation deformity [patella facing medially]. So while revising the wires and schanz pins, the internal rotation deformity was also corrected after disconnecting the distal two rings. Then we waited for the fracture to heal.

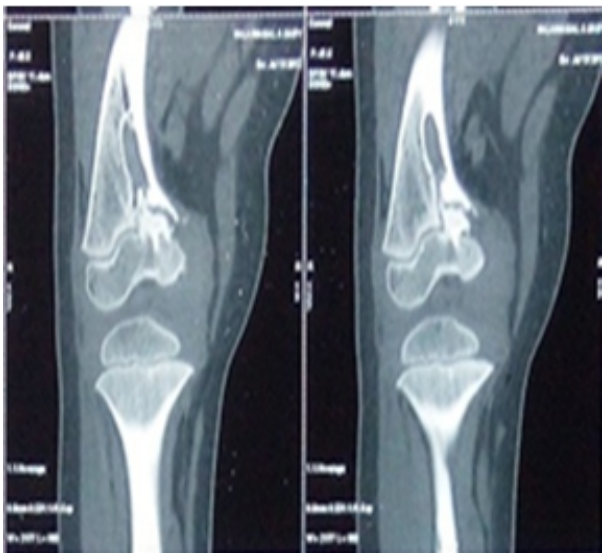

Figure 1: CT scan shows physeal bar in the medial half of the physis in distal femur

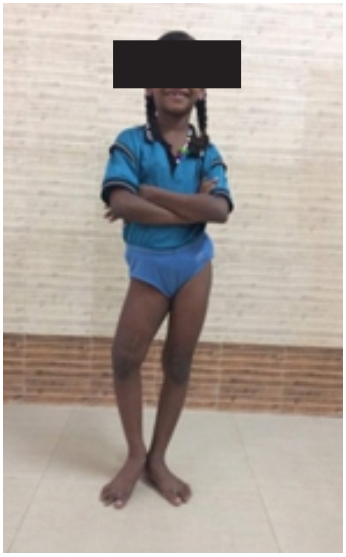

Figure 2: Clinical picture showing varus deformity with shortening

Figure 3: Xray shows varus deformity in the knee arising from distal femur

Once the limb length was achieved [equal to the opposite limb], we calculated the remaining growth of the opposite femur by Anderson chart and found to be 7 cm. So, we over lengthened the ipsilateral femur by further 2 cm. The ring fixator was removed once the regenerate consolidated. To avoid recurrence of varus deformity we induced the lateral physeal arrest [epiphysiodesis] by applying a plate with screws on either side of physis (Fig. 6). We achieved good deformity correction as well as limb length equality [Fig. 7). The range of motion of the knee joint was 0 to 20 degree. She is advised to undergo knee mobilization physiotheraphy to increase the range of movement.

Results

The varus deformity was slightly over corrected to 5 degree of valgus [from 25 degree of varus] over a period of 6 weeks. Then lengthening was started and continued for next 4 months, so that the limb length was over corrected 2 cm longer than the opposite limb [from 8cm of shortening]. The internal rotation deformity was corrected to neutral position. The fixator was removed 14 months after application, once consolidation was achieved. This included the time required for healing of the fractured regenerate. The lengthening index was 1.4 cm/month. The mechanical axis deviation at the end of deformity correction was 5 mm lateral to knee joint center [from 30 mm medial to the knee joint center]. The range of motion after two months of fixator removal was 0 to 20 degree. The patient is undergoing knee mobilisation exercises to further improve the range of motion. The remaining growth [at 10 years of age] in the opposite femurwas calculated using Anderson chart, and was found to be 7 cm. Based on this, an additional 2 cm lengthening was done. We encountered one major complication in the form of regenerate fracture while the fixator was insitu. This was managed by reapplication of schanz

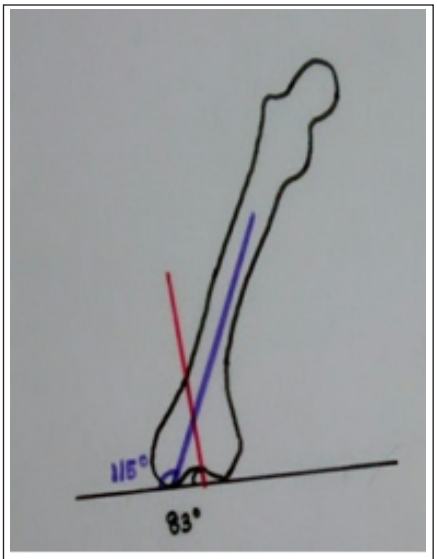

Figure 4: CORA was identified by applying a LDFA of the normal side to the affected side

Figure 5: Xray view showing fracture in the regenerate

Figure 6: Xray after deformity correction and lengthening shows restoration of mechanical axis.

Figure 7: Final clinical picture at latest follow up showing good deformity correction

screw.

Discussion

The complication rate is relatively higher in femoral lengthening [3,4], owing to the peculiarity of femur with regard to disparity between anatomical and mechanical axis, and the influence of large muscle groups on the adjacent joints during lengthening. Moreover to achieve good functional outcome with less complications, femoral lengthening should be restricted to less than 5cm [5] or maximum of 25% femur length [6]. Femoral lengthening with unifocal osteotomy [as in our case] is sufficient in most of the patients. Bifocal treatment is indicated when there is large amount of lengthening required, and also in patients in whom the stability of the construct does not allow for lengthening at the site of deformity correction [7]. In our case we have managed with unifocal osteotomy [osteotomy rule 2] to achieve correction of angular deformity [varus and internal rotation] and also correction of limb shortening.

According to mechanical studies of external fixator designs, optimal design for an external fixator is one that is rigid in torsion, bending and shear, but allows for axial movement [8,9]. Paley et al found that orthofix monolateral fixators prevent axial motion at the osteotomy site [10]. The low frame rigidity seen at lesser loads allows more axial motion stimulating callus formation, and higher frame rigidity seen at increased loads protects the healing bone from excessive motion. This mechanical property explains why Ilizarov frame promotes osteogenesis whereas other frames fail [11, 12]. Moreover, correction of multiplanar deformities in addition to lengthening is an advantage of Ilizarov over monolateral frames.

According to Daniel E prince et al [6], the usual rate of improvement in range of motion after lengthening is 10 degree /month, but the last 20 degree of knee flexion may take upto 2 – 5 yrs to recover [6].

According to Dror Paley, overlengthening of 10 mm followed by shortening of 15 mm overcomes the problems of muscle contracture [13]. The over lengthening is also performed to compensate for the remaining growth in the opposite limb [6]. In our case, we have over lengthened by 2 cm (using Anderson chart) to compensate for remaining growth in opposite limb. Another method to maintain limb length equality is by epiphysiodesis of the contralateral limb [14], but we have performed epiphysiodesis of the ipsilateral lateral femoral condylar physis to prevent problems of recurrent varus deformity.

Conclusions

Eventhough deformity correction along with lengthening is challenging in femur because of its peculiarities, ring fixator provides multiplanar deformity correction to achieve correction in six axes. Ilizarov apparatus suits this purpose than monolateral fixators due to its mechanical properties. In children, over lengthening is advised in the ipsilateral limb, and / or epiphysiodesis in the contralateral limb to compensate for remaining growth in opposite limb. Epiphysiodesis in the ipsilateral femur prevents recurrence of deformity. Intensive physiotherapy over a prolonged period is essential to restore the knee range of motion.

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Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Dhurvas R R, Sengodan V C, Vellaiyan S.| Correction of coronal, rotational deformity and shortening in a paediatric femur using Ilizarov technique – A case report.| International Journal of Paediatric Orthopaedics | Jan-April 2020; 6(1): 20-23.