

# Leap with LAP: results of Plating after Lengthening procedure in children

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## **Introduction:**

Limb lengthening was revolutionized by introduction of concept of distraction osteogenesis by Ilizarov. Complex and extended lengthening of deficiencies could be accomplished due to this concept coupled with an external fixator. However, external fixator had its own demerit of extended time frame in application throughout the distraction and consolidation phase. This places a high demand on patients with morbidity of the frame and complications of pin tract infection (7.5 to 80%), joint stiffness and risk of refracture and deformity after frame removal (8 to 30%).

To circumvent these problems and facilitate less external fixator time, lengthening over nail (LON) was devised and found effective, to help regain quick range of motion and protect the regenerate from fracture. However, it carries a high risk of deep intramedullary (IM) infection and its inability to use this procedure in children with an open physis.

Lengthening over plate, the procedure practiced in this study, does not carry the risk of deep IM infections and can be used to children without the risk of damage to physis. Also, the introduction of locking plate further adds to the physiological benefits of minimal invasive application and strong construct to prevent the loss of fixation and alignment and prevent the creation of bending deformities when used as bridging plate across the regenerate bone.

This study therefore evaluates the efficacy of LAP techniques on the parameters of, (1) External fixator index, (2) Bone healing index, (3) Lengthening amount, (4) Time to consolidation, (5) Duration of exfix, (6) Return to school.

## **Material and methods:**

We performed a retrospective analysis of patients who underwent LAP at our institute from 2008 to 2020 after approval from institutional review board and informed consent were obtained. The study had 21 patients with LAP (Femur 6, Tibia 13, Humerus 2) with age group 6-18 years. The causes of lengthening procedure were infection/osteomyelitis (15 patients), congenital LLD (05 patients), Posteromedial bowing (01). All patients were operated with monolateral external fixator and subsequently with locking plate fixed with minimally invasive approach. Mean follow up period was 80 months (28 to 130 months).

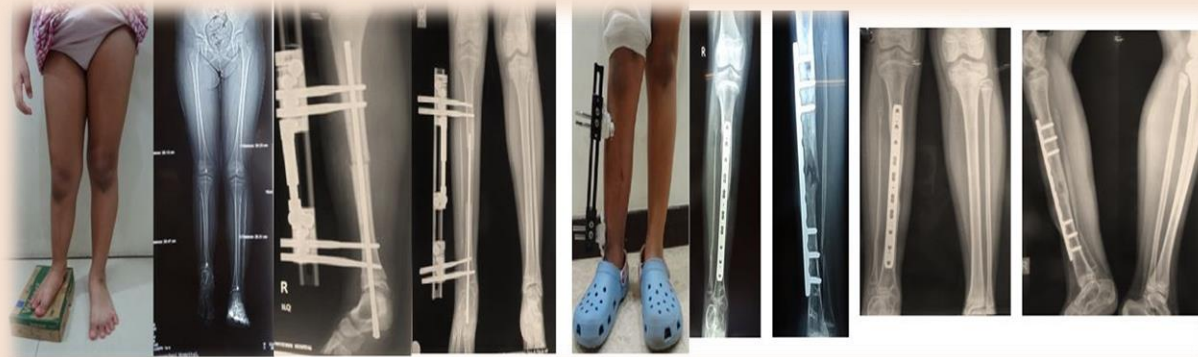
The procedure consisted of lengthening with monolateral fixator followed by removal of fixator and plating within 2 weeks of stopping distraction. The steps included placing temporary maintenance ex-fix, removal of lengthening device, lavage, percutaneous insertion of locking plate correcting translation angulation and rotation, fixing the plate with locking screws.

## Results:

The mean lengthening amount 4.3 cm (3.2–7.5). The mean duration of external fixator was 69 days (48–87) and the mean external fixator index was 16.0 days/cm (12.3–19 days). The mean time to consolidation was 152 days (122–223) and the mean healing index was 35.34 days/cm (28 –55). All children were able to start the school with mean return to school time being 97 days (82-155).

Complications included minor discharge in 2 patients which responded well to oral antibiotics. One patient needed surgical lavage and iv antibiotics administration. One patient further required bone grafting. Two patients needed revision surgery for bent plate.

No patient has joint stiffness, knee flexion contracture, ankle equinus or refracture. At final follow up, all patients had returned to full, unassisted weight bearing and full range of motion at adjacent joint. All surgical sites looked healthy.



From Left. A case nine year of female child with tibial shortening of 4 cm; Scannogram confirming the tibia origin of the shortening; osteotomy done with monolateral external fixator and IM nail; distraction done and 4 cm length achieved; fixator and IM nail removal and tibial locking plate application ( 1 month follow up) ; final follow up at 8 months.



From, top left, case of idiopathic posterior medial bowing of tibia; with final LLD of 4 cm at age 7 (2,3,4 images) ; underwent monolateral external fixator with osteotomy; followed by distraction and achievement of 4 cm lengthening, however the distal fragment went into valgus deformity; removal of fixator with correction of the deformity with a plate; follow up at 1 month; final follow up at 8 months.



From, left, post septic knee sequelae with femoral angulation and shortening, presents with LLD; Stage 1 external fixator application with osteotomy and IM nail; Stage 2 distraction done length of 3.5 cm achieved; Stage 3 fixator removal and distal femoral osteotomy to correct knee fixed flexion deformity with plating across the osteotomy site and extending into the regenerate callus.

### Discussion:

Distraction osteogenesis has been the widely accepted treatment modality for deformity correction, bone lengthening and treatment of nonunion. However, it's not without complications and these complications arise from prolonged duration of fixation which hampers with early rehabilitation.

With aim of reducing fixation time in paediatric patients, our study employs gradual distraction with external fixator followed by minimally invasive locking plating over the distracted callus.

	<b>Our study</b>	<b>Chang- Wug et al.</b>	<b>Soo-Min Cha et al.</b>	<b>Harbacheuski et al.</b>
<b>Lengthening amount (in cm)</b>	4.3	5.47	4.23	3.6
<b>Duration of Ex fix (days)</b>	69	NA	54.9	135
<b>Time to consolidation (days)</b>	152	NA	195.7	57.8
<b>External fixator index (days/cm)</b>	16	26.93	13	33
<b>Healing index (days/cm)</b>	35.34	52.01	46.1	60.3
<b>Return to school (days)</b>	97	NA	NA	NA

In our study, this method was successfully in reducing fixator time and results were comparable to the existing literature. The study showed significant improvement in healing index which could be attributed to minimally invasive technique of plating and the use of locking plates itself which proved a more physiological and stronger construct. Also, we were able to report, the time required for a child to return to his/her school, which could be equated to the patient's regaining functional status, in a mean of 97 days.

Additionally, the study also reflected that even though this technique required the child to undergo a second surgical intervention, it provided the surgeon to correct the misalignment occurred during the course of fixator time and co-existing bony deformity during the second procedure while maintaining the integrity of the distracted callus.

Hence, it's our opinion, that this lengthening and then plating (LAP) is a novel technique to be used in treating a case of length discrepancy. It allows early fixator removal, a faster bone healing, quicker return to functional activity and a chance to intervene for correction of any discourse from acceptable correction. It does require a second surgical procedure, which adds to the surgical stress and cost of the treatment and should be explained and consulted with the parents.

This study is not without its limitation, in being retrospective and lacking another comparable group with different acceptable treatment regime like Lengthening over an IM nail (LON). Despite these limitations, we opine that LAP is a fair procedure of treatment and must be considered when treating a case of length discrepancy.