Paediatric Limb Lengthening

## Measurement of Length



Galeazzi sign can help detect clinically if the shortening is in the Femur or Tibia if the extent of shortening is significant.

### Scanogram Full Length Xray



Scanogram is very useful when there is a contracture of the knee or hip joints which can cause an error in reading. Full Length xrays help determine if shortening is in pelvis, Femur or Tibia or the Spherion.



## Golden Rules of Lengthening

## Seven Golden Rules

- Stable Fixation
- Atraumatic Corticotomy
- Latency
- Rate of Distraction
- Rhythm of Distraction
- Preserve Vascularity
- Preserved Function

## Stable Fixation

- More pins & wires
- More threaded rods
- More rings
- Rings closer to the site of lengthening
- Proper tensioning of wires in ring
- Proper clamping of Pins in ring



- Classic Corticotomy.....all wire frames
- Drill Hole Corticotomy......half pin frames
- Gigli Saw osteotomy.....short fragments
- Should be atraumatic and other five rules must be followed to monitor the process of limb lengthening.





#### Relative ability of young and mature muscles to respond to limb lengthening

T. Shisha, S. Kits, K. Pap, H. Simpson, G. Szöke The response of the muscle is critical in determining the functional outcome of limb lengthening. We hypothesised that muscle response would vary with age and therefore studied the response of the muscles during tibial lengthening in ten young and ten mature rabbits. A bromodeoxyunkline technique was used to identify the dividing cells. The young rabbits demonstrated a significantly greater proliferative response to the distraction stimulus than the mature ones. This was particularly pronounced at the myoterglasse junction, but was also evident within the muscle terty.

From Sommelwein University, Budaped, Hungary

myoterginous junction; but was also evident within the muscle bery. Younger muscle adapted better to lengthening, suggesting that in potients in whom a large degree of muscle lengthening is required it may be beneficial to carry out this procedure when they are young, in order to achieve the optimal functional result.



#### Response of the tendon during limb lengthening

G. Szölor, S.-H. Ler, A. H. R. W. Simpson, J. Prescott

From the University of Edinburgh, Edinburgh, Scotland Little is known about the increase in length of tendons in postnatal life or of their response to limb lengthening procedures. A study was carried out in ten young and nine adult rabbits in which the tibia was lengthened by 20% at two rates 0.8 mm/day and 1.6 mm/day. The tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in the tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in tendon of the flexor digitorum longus (FDL) muscle showed a significant increase in tendon of the flexor digitorum (FDL) muscle showed a significant increase in tendon of tendon of the flexor digitorum (FDL) muscle showed a significant increase in tendon of tendo

length in response to lengthening of the tibls. The young rabbits exhibited a significantly higher increase in length in the FDL tendon compared with the adults. There was no difference in the amount of lengthening of the FDL tendon at the different rates. Of the increase in length which occurred, 77% was in the proximal half of the tendon.

This investigation demonstrated that tendors have the ability to lengthen during limb distraction. This occurred to a greater extent in the young who showed a higher proliferative response, suggesting that there may be less need for formal tendon lengthening in young children.

When shortening is significant and will result in a large Limb Length discrepancy, the author feels it is much better to start lengthening as early as possible.







One and half year old child with Congenital PosteroMedial Bowing of Tibia has 3 cm shortening at this age. Parents insisted on early lengthening.





This child had a 3 cm lengthening in the tibia without much trouble. He was happily playing about within days of the surgery. The fixator is well tolerated if done right!



He continued to do well with almost equal limb lengths for a long time.





He came again at age 12 years with 4.5 cm shortening.



He came again at age 12 years with 4.5 cm shortening. A proximal tibial lengthening took only 4 months. Standard "Paediatric Orthopaedic" recommendation is to lengthen at a later age & he would need 8 cm length at this age—a formidable task. Genu Varum Bowing deformity

18 month old child from Canada had severe bowing deformity with short stature. Her mother suffers from the same problem and is very short. They saw the logic of operating early for deformity correction as well as lengthening.

8 month old child from Canada had severe bowing











Lengthening of Femur and Tibia was done, one at a time and 3.5 cm length was achieved in each segment for a total of 7 cm length gain.





She had a good correction of her deformities and her mother is happy that her daughter does not have to suffer her fate. She is equal to her peers at school.

## Congenital Pseudarthrosis of Tibia







8 yr old child from Bhopal had a failed ilizarov for Congenital Pseudarthrosis of Tibia. Along with the nonunion and deformity he also had a shortening of 4 cm.





While lengthening is not the most important part of the treatment, it helps in improving blood supply to the limb The surgery included, Open reduction, IM Rodding, Ilia Crest Periosteal grafting, foot frame application and compression at NU site.





He healed very well and the IM rod helped in maintaining union. The restoration of limb length helpe mechanics of the limb and also improved blood supply the the limb.

# Postero-Medial Bowing of Tibia





We contrast the earlier example of Congenital Posteromedial Bowing of Tibia with this young lad at ag 12 years who presents with 7 cm of shortening. In 8<sup>th</sup> std in school treatment will be long and troublesome.





A double level lengthening was done to reduce treatment duration. Lengthening was a little more difficu with tendency for axial deviation etc, (which we controlled)





Duration of treatment was 6 months and limb lengths and now equal with no significant deviation or any other residual problem. The outcome is very successful.

## Radial Club Hand Radial lengthening





3 yr old with a rare variant of Radial Clubhand with only the distal radius absent and a Pouce flottant thumb.



We lengthened his radius by 5 cm. Treatment was not too tough on the young lad.



With equal forearm lengths, he is one happy young man.

Radial Club Hand Ulnar lengthening

13 year old had a previous surgery for centralization with a recurrent deformity and shortening. Her father wished that her forearm be straight.





Ulnar lengthening of 6 cm was done and soft tissue distraction of the manus at wrist level to correct the deformity in the forearm.



At 5 months her lengthening zone is healed up. Her forearms are equal in length and hand appears straight which makes her and also her parents very happy. Forearm Lengthening





GB is 12 yrs old and has shortening of both her Radius and Ulna and the Whole forearm. Excision of a exostosis was done in childhood.



Separate carbon fibre rings for Radius & Ulna were used And lengthening of both bones to different extents was done.




Ulna needed 4.5 cm lengthening which was done proximally through the broad proximal metaphysis. Radius needed 7 cm lengthening which was done at the distal broad metaphysis.



Treatment lasted 5 months and she was attending school for the last 4 months of 5. The Distal RadioUlnar Joints are congruent & both forearms are of equal length





#### Forearm Rotations are normal.



# Wrist movements are almost full within 6 weeks of apparatus removal.





FB is a pretty 12 yr old with HME with a short Ulna and bowed radius which is subluxing from the PRUJ. Forearm is short and deformed.



She had a proximal ulnar lengthening of 5 cm which allowed the DRUJ to line up and Radial head to come down properly at level of Capitellum.



Radius Ulna relationship is restored. Forearms are equ and wrist movements are excellent.

#### Humerus Lengthening



AP is a 14 yr old who had childhood osteomyelitis of upper Humerus with growth arrest causing the R arm to be more than 14 cm short.





LRS fixator was applied and lengthening done through mid diaphysis at a single level.



12 cm length was achieved which creates the appearance of Upper limb lengths being equal.





Bone has healed well without problems and Elbow movements are good.

## Oblique Plane Def

With Rotation





6 yr old with post-osteomyelitis growth arrest has shortening of the limb with a gap in the upper tibia and severe Internal rotation deformity of the limb due to overgrowth of the fibula. His foot points backwards.



We lengthened his tibia distally to fill up the gap at the upper end, osteotomised the fibula and then de-rotated the whole limb.





Limb Lengths are equal and the foot now points in th front and is a human limb after 5 months of treatment.

#### Fibular Hemimelia





AH presented with shortening and absent 3 rays of the foot at age 7 years. We started by lengthening the low femur and upper tibia to equalize his limb lengths .



He returned at age 12 years with progressive shortening and valgus deviation. We repeated a Tibial Lengthening to give him 4.5 cm and corrected the valgus as well.



Final lengthening of 5 cm was repeated when he can a age 15 years.

Shows his limb before and after the last lengthening with full function.





#### Tibial Hemimelia





EC came to us at age 8 months with a severe form of Tibial hemimelia with absent distal tibia and severe deformity of the foot.





We performed a epiphysiodesis of the distal fibula and soft tissue release to correct her foot deformity in the first stage.



At age 4 years she had an Ilizarov treatment to lengthen her tibia and correct her foot deformity.



We had to repeat the treatment when she presented again at age 10 years with this deviation.



## A repeat Tibial lengthening and foot deformity correctio was done



At the end of her third treatment her Leg length difference is only 5 cm and her lower tibia is missing only by about 6 cm. She will need two more lengthening treatments perhaps to equalize.

### **Congenital Short Femur**



AS came to us from the Middle east with Congenital short femur at age 5 years with 12 cm shortening. Her hip was shallow with a small CE angle.







We started with the preparatory surgery of Dega Osteotomy and then a tibial lengthening after a few weeks.







At age 8 years, we went ahead with a femur lengthening of 5 cm



At 11 years she is only 5 cm short on her R leg, has good movements and is an accomplished dancer.

Extensive Limb Lengthening for dwarfism Hypochondroplasia





KM has Hypochondroplasia and at age 13 yrs presents with short stature.


We performed a double level tibial lengthening of 10 cn which was relatively easy to tolerate for him.



He and his father are both happy and he has straight limbs and is now almost equal to his peers at school. Achondroplasia





RM is the daughter of a General Practitioner and suffer from Achondroplasia. At age 8 yrs we started with cross lengthening.



Double Level tibial lengthening gave her 12.5 cm and Femur lengthening gave her 10 cm of length.





She started the second phase within a few months of completion one set. Total height gain was 22.5 cm



Body proportions were restored by Humerus lengthening of about 8 cm.



She and her father are happy with the outcome –which has certainly changed her life. Her movements are full and she is now a medical student –making a normal life for herself.

## If you do it right.....



Dr Chaudhary with Prof Ilizarov in 1988. His abiding legacy is our ability to help children with limb length discrepancy of all types.

## Thank You

## milind.chaudhary@gmail.com