GROWING UP EVENLY

The innovative pathways to rectifying Paediatric Leg Length Discrepancies at the Children's Hospital at Westmead

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Leg Length Discrepancy (LLD)

LLD refers to a difference in the length of an individual's legs, either due to congenital malformations or acquired changes due to abnormal growth, infection, tumours, or trauma (Khamis & Carmeli, 2017).

Children with leg length discrepancies greater than 2.5cm often experience increased exertion to maintain their center of gravity when performing simple movements such as walking. This can lead to long term negative outcomes including joint pain, limping and arthritis (Blanco & Widmann, 2023).

The medical journey for a paediatric patient with a LLD can be simple or complex and can include specialist referral, diagnosis, monitoring, treatment options including major limb lengthening surgery in complex cases, and ongoing management and follow up care.

Leg lengthening occurs via the principle of distraction whereby a bone is broken and separated slowly, allowing new bone to fill the distracted space. The average femur can be distracted at a rate of 1mm per day and the average tibia 0.75mm per day. It can take up to 2-3months post lengthening for new bone to solidify and lengthening devices may need to stay in situ until full union is achieved (International Center for Limb Lengthening, 2024).

Diagnosis of LLD & Treatment techniques at CHW

The diagnosis pathway for children with LLD begins when parents either notice a visible difference in leg length or symptoms appear such as lower limb joint pain or limping.

Patients are referred to the Orthopaedic clinic at CHW for specialist assessment. This is followed with initial leg length imaging using the EOS system for standing compliant patients or the Long tail DR system for all other patients.

Measurements are made from the x-rays to determine whether a LLD exists, which bones contribute to the LLD and what treatment options are available. Common treatment options used at CHW include:

- External Fixator Frames
- Intramedullary nail
- 8 plates
- Epiphysiodesis
- De-rotational osteotomy

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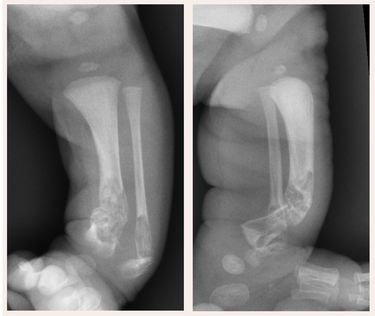
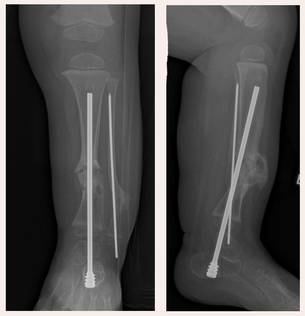
CASE STUDY: CONGENITAL PSUEDOARTHROSIS OF THE TIBIA (CPT)

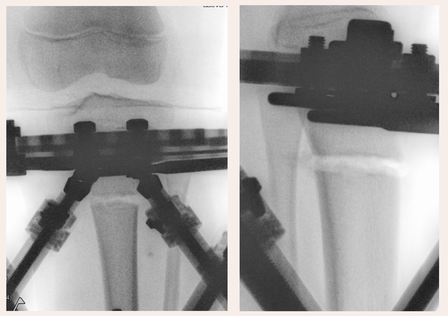


10 DAYS OLD
INITIAL IMAGING
Dx: Congenital Pseudoarthrosis of the Tibia



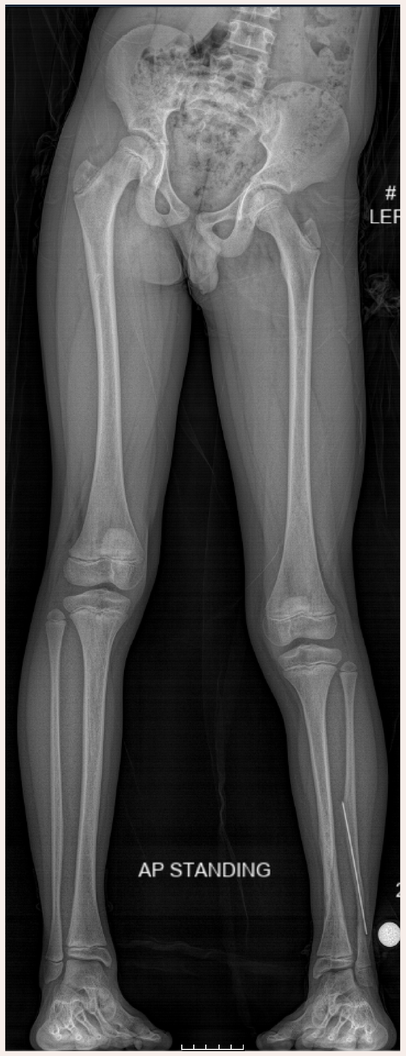
2 YEARS OLD
Deformity correction by Tib/Fib Osteotomies; Intramedullary nail and K-Wire insertion

11 YEARS OLD
Biological age: 11y 6mo
Bone age: 12y 6mo



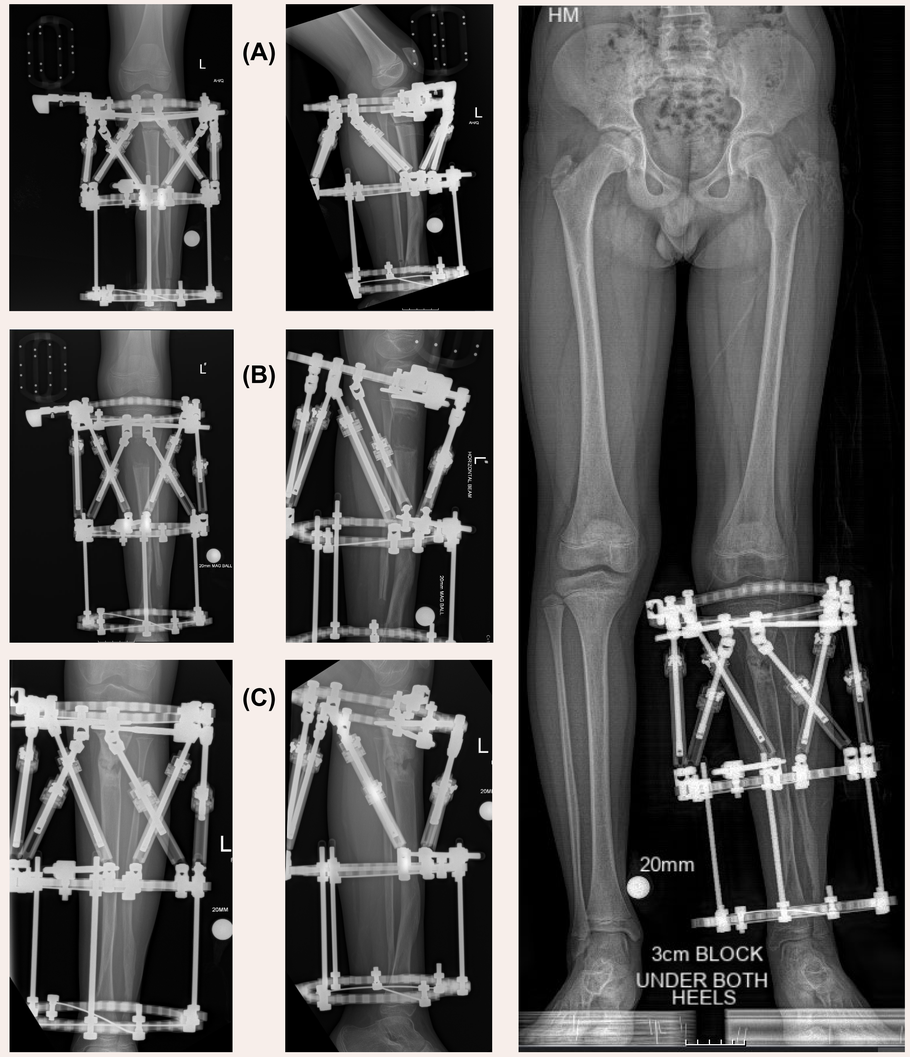
11 YEARS OLD
II imaging of Tibial Osteotomy & Hexapod Lengthening frame application

PRE-LENGTHENING



4.5cm LLD reported

POST-LENGTHENING



Equal leg length 6months post completion of lengthening
Complete union almost achieved
Patient started on Bisphosphonate therapy to promote union

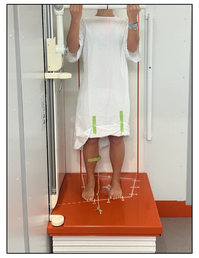
(A) Lengthening Day 1 (patient to lengthen at home using MyTSP App 0.75mm per day)
(B) Final Day of lengthening (Day 47)
(C) 7months post completion of lengthening – almost complete union

The Role of Medical Imaging in LLD

Medical Imaging is a vital tool for diagnosis, monitoring, pre-surgical planning and post-operative management of patients with LLD. Intraoperative imaging under image intensifier guidance is also required in cases requiring surgery.

Leg Length X-ray Technique at CHW:

- Use either EOS or Long tail detector system depending on patient capabilities
- Include from Iliac crest to bottom of feet in one image
- Both legs taken in the same image
- Patella's facing forwards for true AP
- 20mm Magnification marker placed on the patient in line with the bone for accurate measurements (should not obscure any anatomy)
- Even weight distribution on both legs
- Wooden blocks to be placed under the shorter leg of patients with suspected or known LLD to straighten the pelvis
- Technique must remain consistent between staff to ensure accurate measurements at each follow up appointment.



Bone Age X-Ray Technique:

- Left PA hand and distal 1/3 of wrist x-ray to determine patient's bone age
- Bone age determination can assist in predicting the remaining potential for longitudinal bone growth and therefore influences the treatment techniques possible for different patients and the decisions made by Orthopaedic teams regarding the timing of surgical interventions.

Intra-Operative Imaging using Image Intensifier:

- II imaging is often used during limb lengthening surgery at CHW to guide hardware placement, ensure adequate limb alignment and fixation, and in the case of intramedullary nail insertion, to aid testing of the magnet prior to surgery completion.
- Imaging to be performed in accordance with the ALARA principle
- Reduce magnification as much as possible
- AP and Lateral imaging required throughout these procedures

Acknowledgements

- Dr Oliver Birke, CHW
- Dr Justine St. George, CHW

References

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