ISUOG Basic Training

Distinguishing between Normal & Abnormal Appearances of the Long Bones & Extremities

Learning objectives

At the end of the lecture you will be able to:

- Describe how to obtain the planes required to assess the four limbs correctly
- Recognise the differences between the normal & most common abnormal ultrasound appearances of the legs, arms & extremities

Key questions

1. What are the key ultrasound features of plane 15 (femur) when measuring the femoral diaphysis length?
2. What are the key ultrasound features of plane 16 (leg)?
3. What are the key ultrasound features of plane 17 (arm)?
4. Which probe movements are required to image the 3 long bones of a limb & extremity correctly?
5. Which abnormalities should be excluded after correct assessment of planes 15 (femur), 16 (leg) & 17 (arm)?

The 20 + 2 planes

Anatomical area	Plane	Description
Overview 1	Sweep 1	Longitudinal head & body for initial orientation
Spine	1 2 3	Sagittal complete spine with skin covering Coronal complete spine Coronal section of body
Head	4 5 6	Transventricular plane* Transthalamic plane* Transcerebellar plane*
Thorax	7 8 9 10	Lungs, 4 chamber view of heart Left ventricular outflow tract (LVOT) Right ventricular outflow tract (RVOT) & crossover of LVOT 3 vessel trachea (3VT) view of heart

* Measurement required

The 20 + 2 planes

Anatomical area	Plane	Description
Abdomen	11 12 13	Transverse section of abdomen with stomach & umbilical vein* Transverse section of abdomen at cord insertion Transverse section(s) of left kidney & pelvis, right kidney & pelvis
Pelvis	14	Transverse section of pelvis, bladder, both umbilical arteries
Limbs	15 16 17	Femur diaphysis length* 3 bones of both legs, both feet & normal relationships to both legs 3 bones of both arms, both hands & normal relationships to both arms
Face	18 19 20	Coronal view of upper lip, nose & nostrils Both orbits, both lenses Median facial profile
Overview 2	Sweep 2	Transverse sweep of body from neck to sacrum, one vertebra at a time

* Measurement required

Requirements from each plane

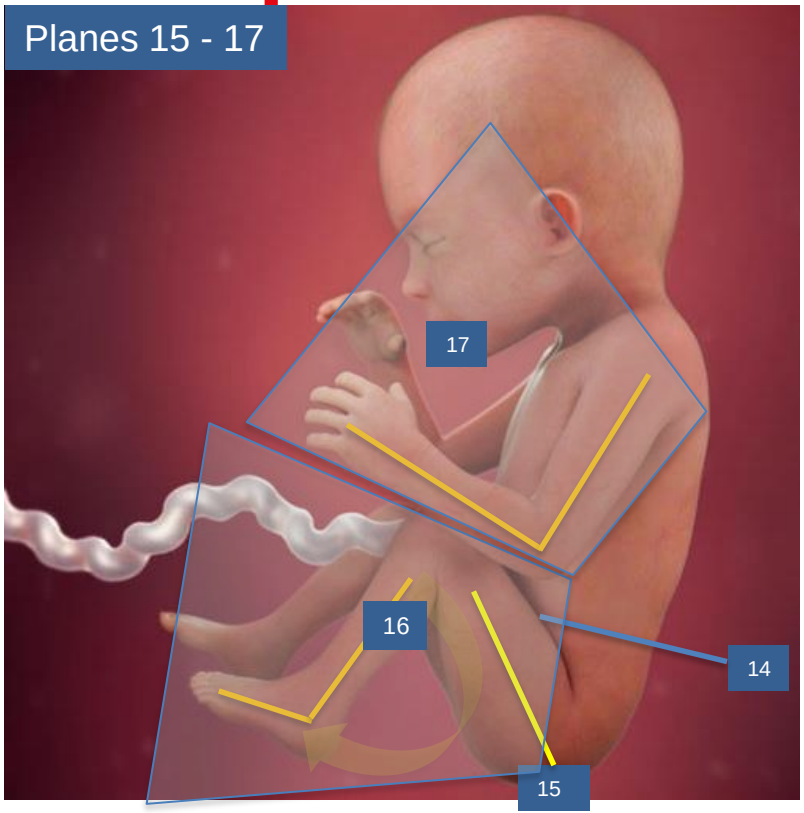
Plane	Description	Structures to be evaluated[2,3,4]	Measurement & criteria for referral	Abnormalities that can be excluded from the normal appearances of the section
15	Femur diaphysis length	Femur length (FL) section	FL, refer if FL outside normal range for size chart	Severe skeletal disorders (some)
16	3 long bones of both legs, both feet & normal relationships to both legs	Femur, tibia & fibula & carrying angle of foot to lower leg on both sides (toe count not required)		Severe skeletal disorders (some) Talipes
17	3 long bones of both arms, both hands & normal relationships to both arms	Humerus, radius & ulna & carrying angle of hand to lower arm on both sides (finger count not required)		Severe skeletal disorders (some) Fixed flexion deformity of the wrist

ISUOG Education Committee recommendations for basic training in obstetric & gynecological ultrasound, UOG, 2014, 43: 113-116
Practice guidelines for performance of the routine midtrimester scan, UOG, 2010, 37: 116-126
Sonographic examination of the fetal central nervous system, UOG, 2007, 29(1): 109-116
ISUOG Practice Guideline (updated): sonographic screening examination of the fetal heart, UOG, 2013, 41(3): 348-359

Moving through the 20 planes

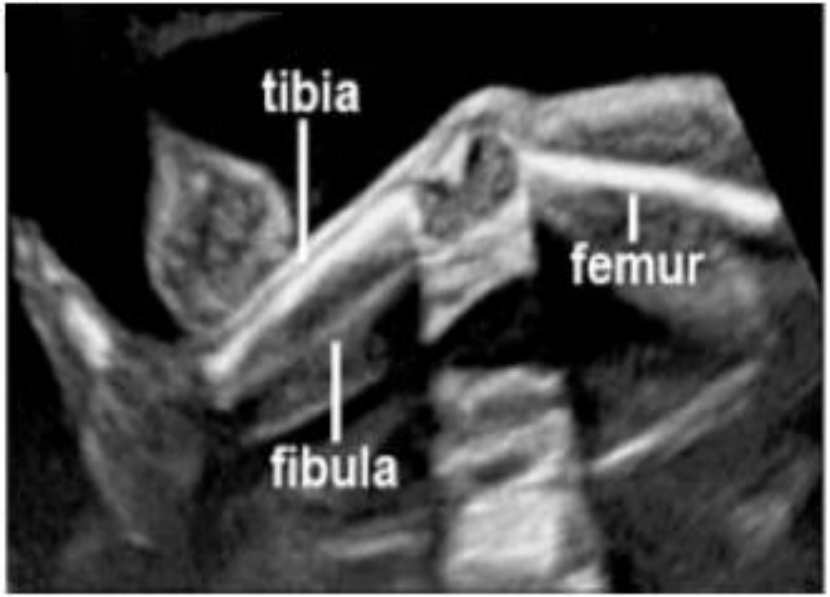
Plane	Description
14	Transverse section of pelvis, bladder, both umbilical arteries
15	Femur diaphysis length*
16	3 bones of both legs, both feet & normal relationships to both legs
17	3 bones of both arms, both hands & normal relationships to both arms

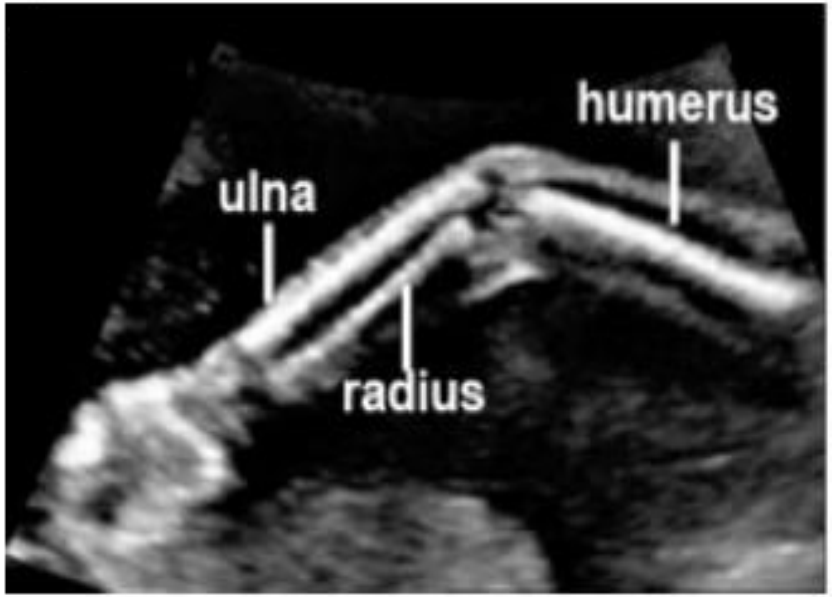
From plane 14 to 15 – slide & rotate
From plane 15 to 16 – slide, rotate (& angle)
From plane 14 to 17 – slide to upper chest, rotate (& angle)



* Measurement required

Planes 15 (femur), 16 (leg) & 17 (arm)

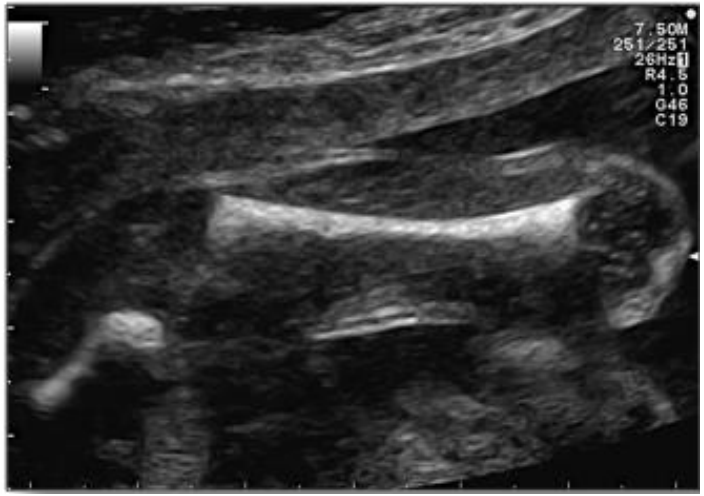


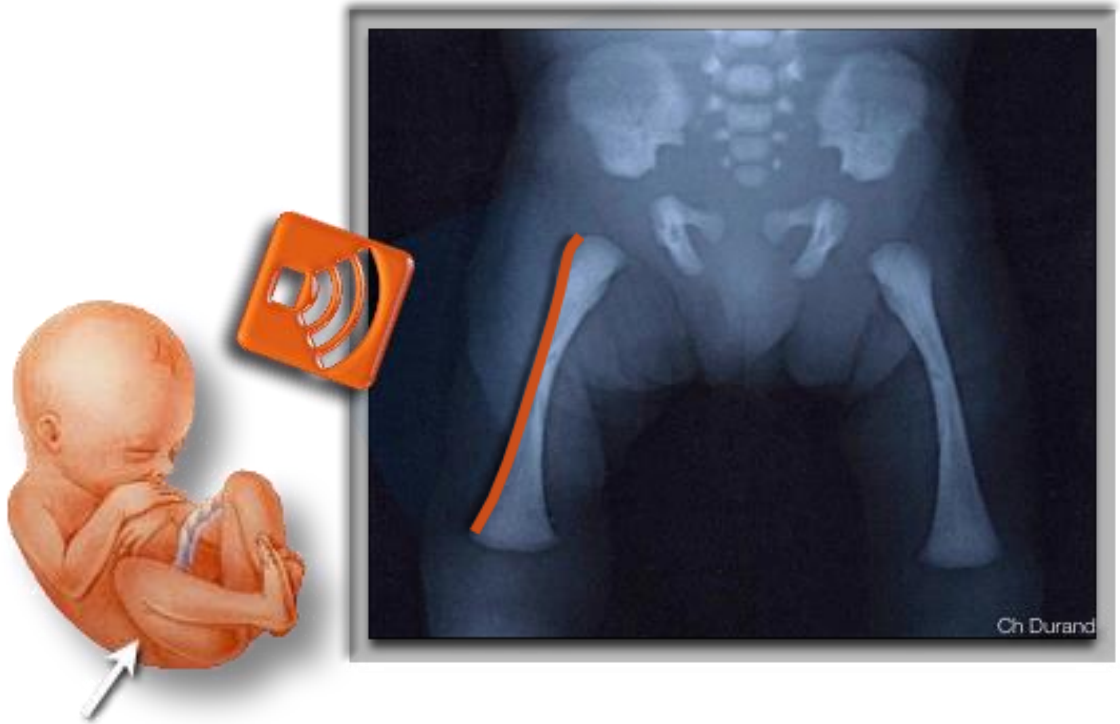


Key ultrasound features of plane 15 (femur)

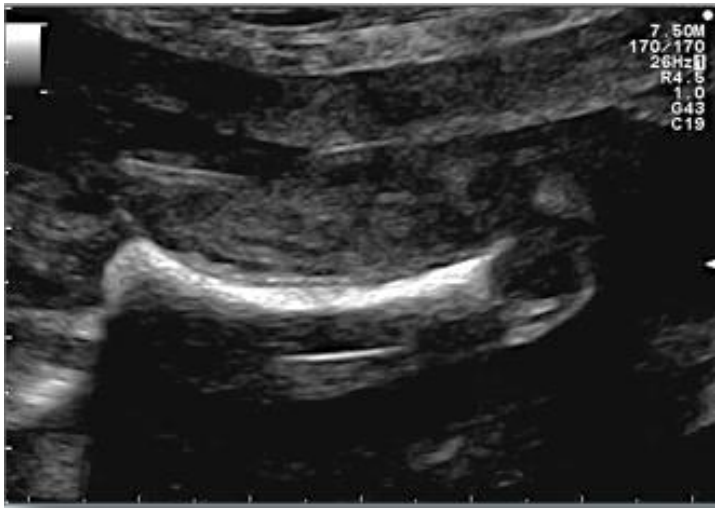
- Focal zone at appropriate level
- Magnification (femur fills >50% of image)
- Whole femur diaphysis imaged
- Beam perpendicular to long axis of femur
- Calipers placed at each end of ossified diaphysis
- Longest visible diaphysis is measured
- Spur artifacts on ends of diaphysis not included in measurement

Plane 15 (femur)





Plane 15 (femur)

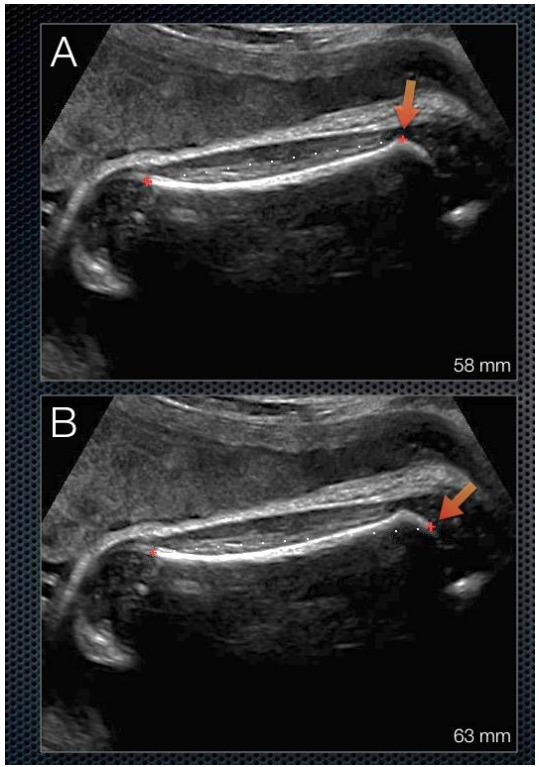


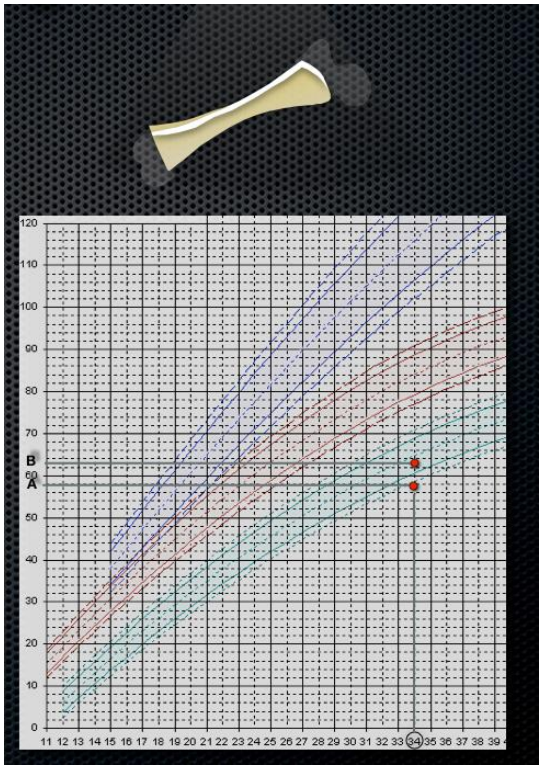
Plane 15 (femur)

Best approach to the femoral diaphysis is orthogonal

- Orthogonal approach
- Measure the antero-external side

Caliper placement

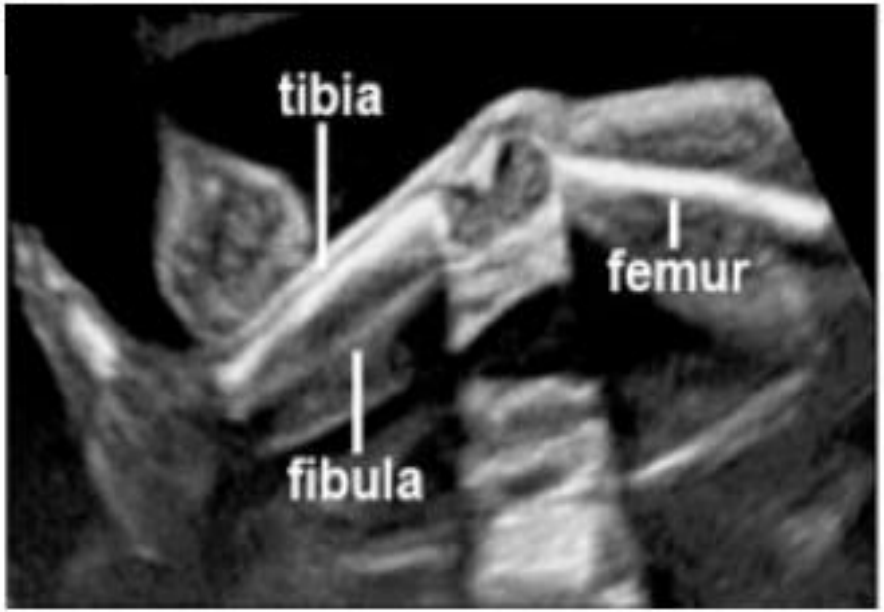




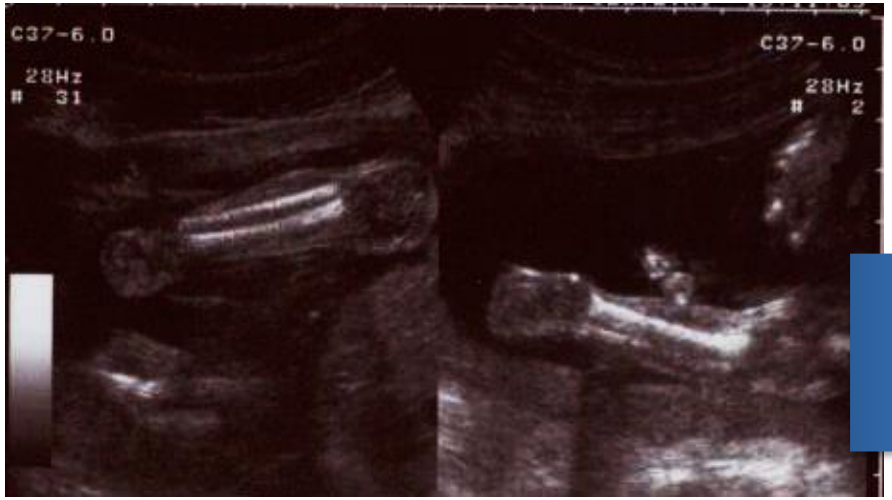
Key ultrasound features of plane 16 (leg)

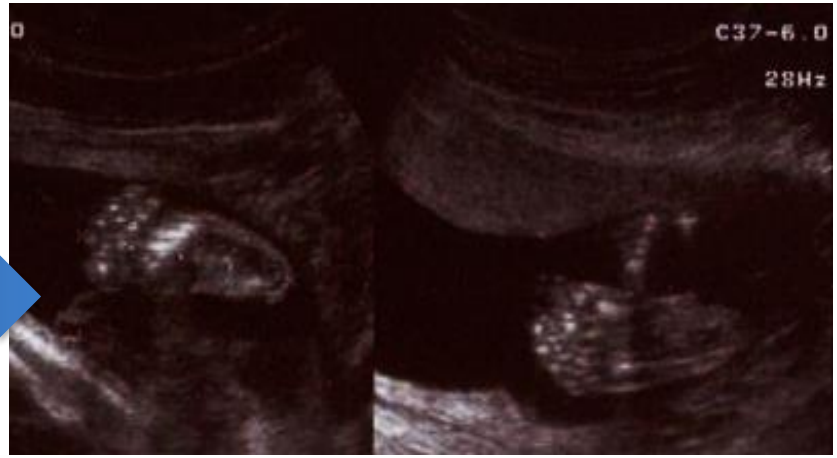
Three long bones of both legs:

- Length
- Echogenicity
- Shape
- Position
- Movements



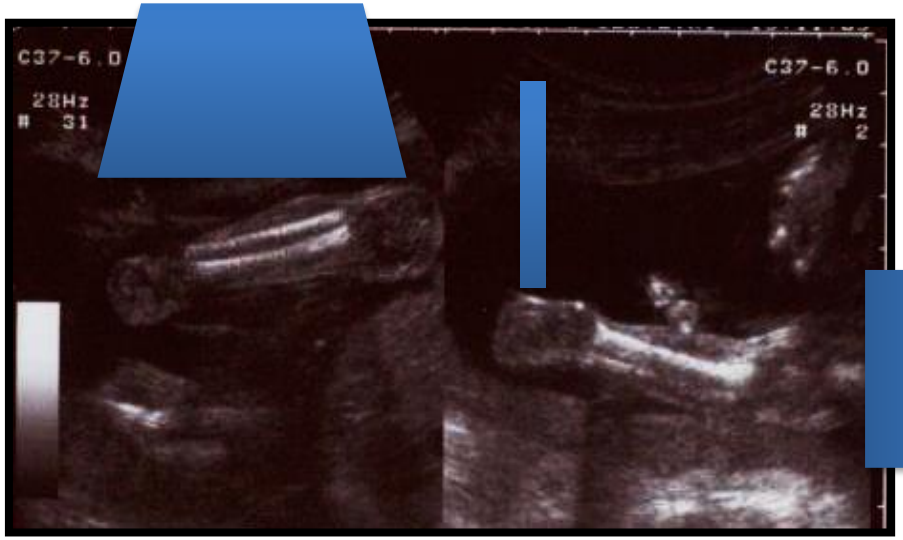
Key ultrasound features of plane 16 (leg)





- 90^0 rotation from tibia & fibula section
- Plantar view of the foot

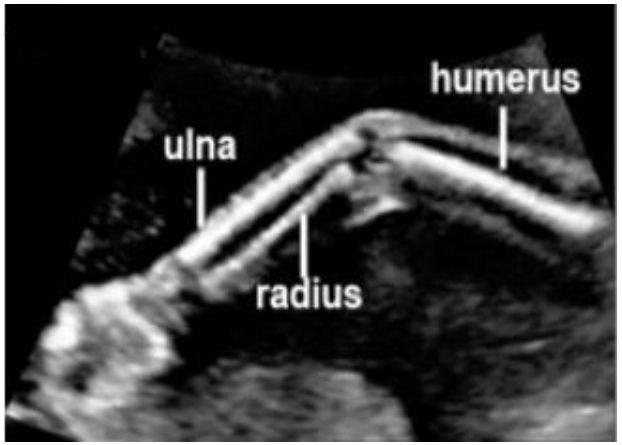
Key ultrasound features of plane 16 (leg)

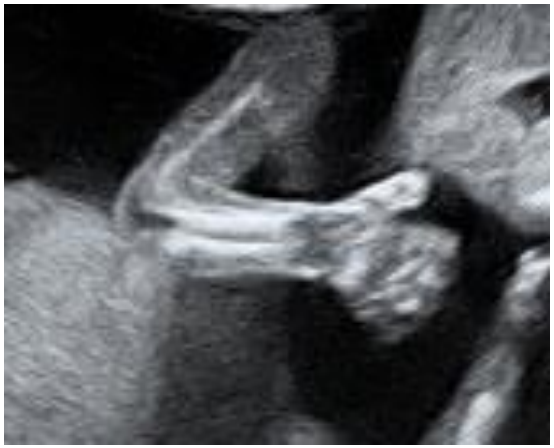


- 90^0 rotation from tibia & fibula section
- Plantar view of the foot

Plane 16 (leg)

Key ultrasound features of plane 17 (arm)



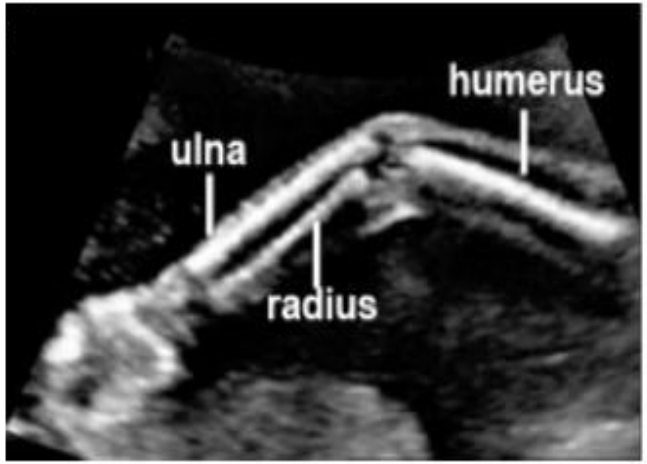


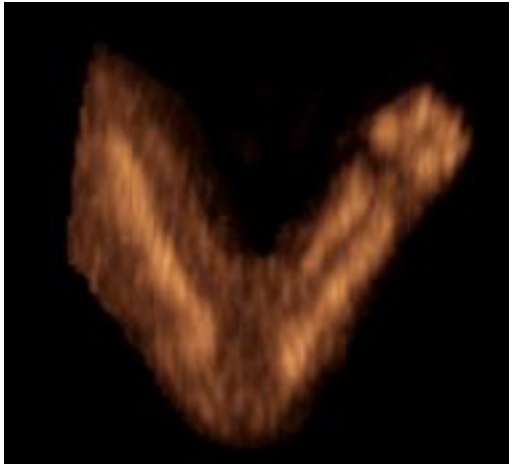
Plane 17 (arm)

Which abnormalities can be excluded after correct assessment of planes 15 (femur), 16 (leg) & 17 (arm)?

- Number of bones
- Length
- Echogenicity
- Shape
- Position
- Movements

Number – plane 17 (arm)





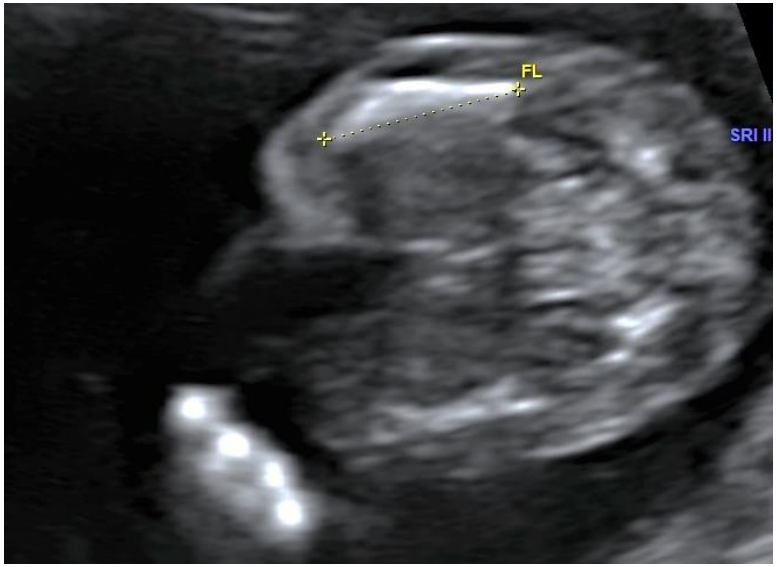
Number

Radial agenesis

Fibula agenesis

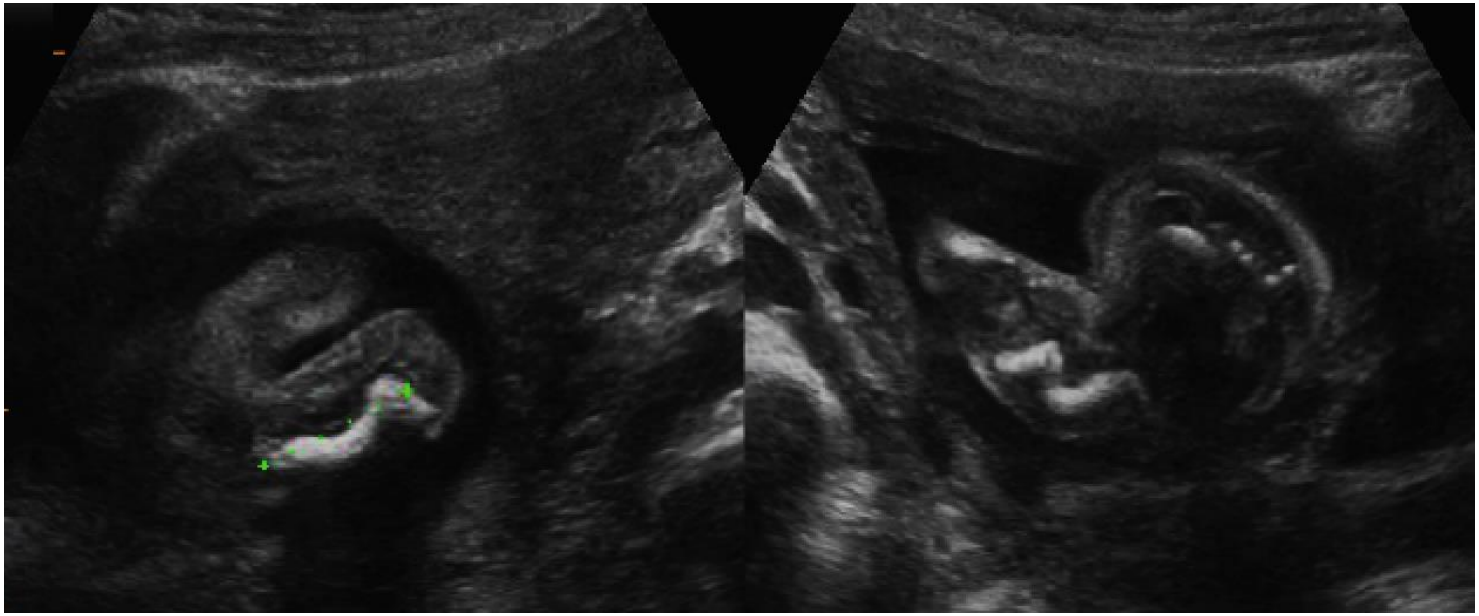
Shape

- Short?
- Curved?



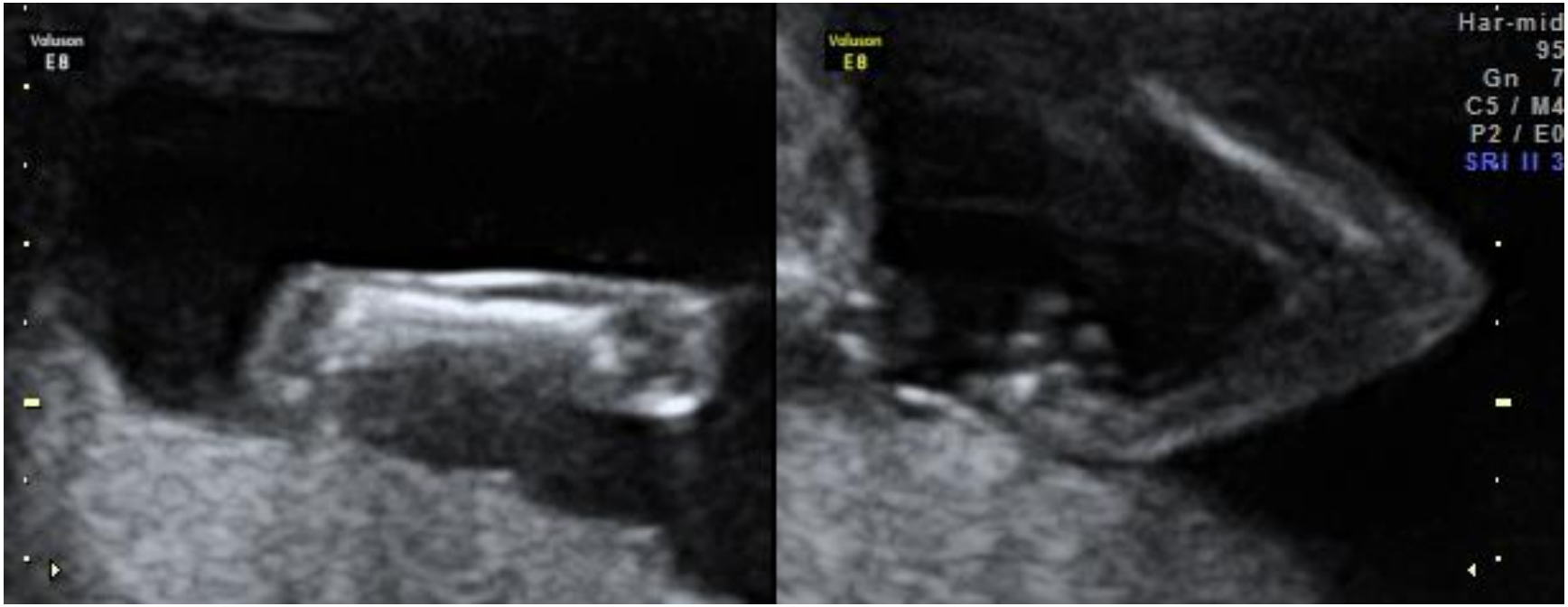
Shape

- Short?
- Curved?
- Fracture?



Position - talipes

Movements



Key points

1. Planes 15 (femur), 16 (leg) & 17 (arm) allow identification of the most common pathologies of the limbs

2. Always check number of bones, shape, position & movements

3. Your role is to distinguish between the range of normal & abnormal appearances

4. Any appearance which you cannot confirm as normal should be referred for a more experienced opinion.