Defining the Spatial Relationships Between 8 Anatomic Planes in the 11+6-13+6 Week Fetus: A Pilot Study

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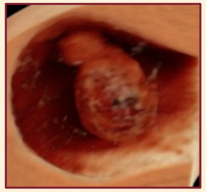
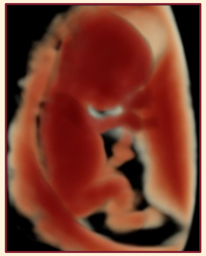
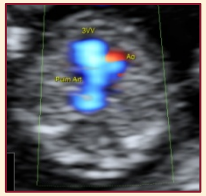
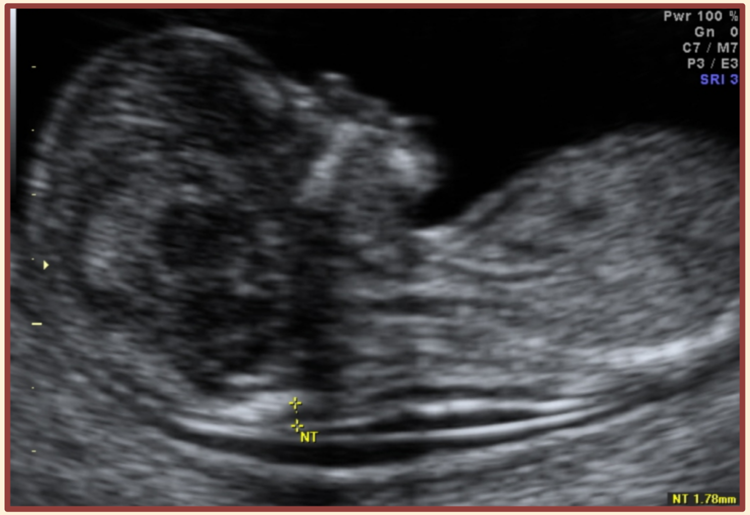
Tripoli - Lebanon

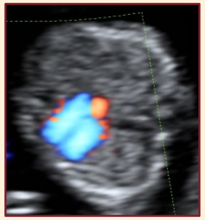


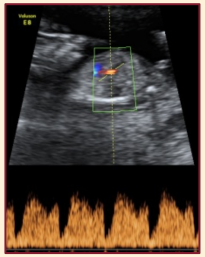










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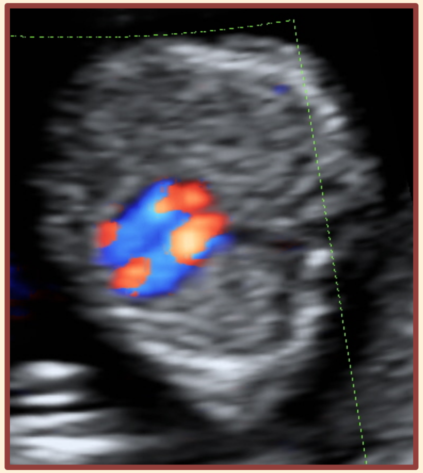
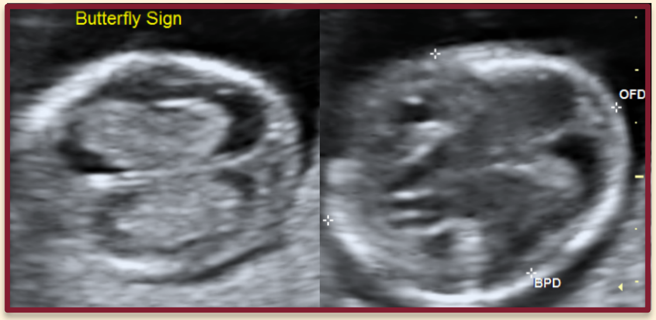
BACKGROUND

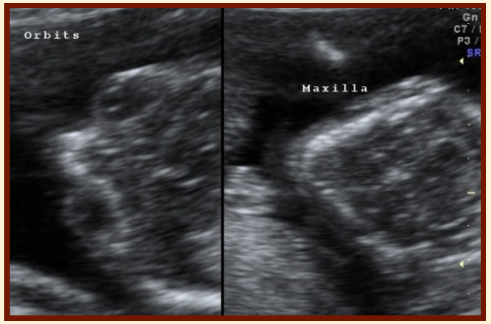
1. Fetal evaluation is feasible at 11-14 weeks
2. There are several limitations at 11-14 weeks
3. Role of 3D sonography

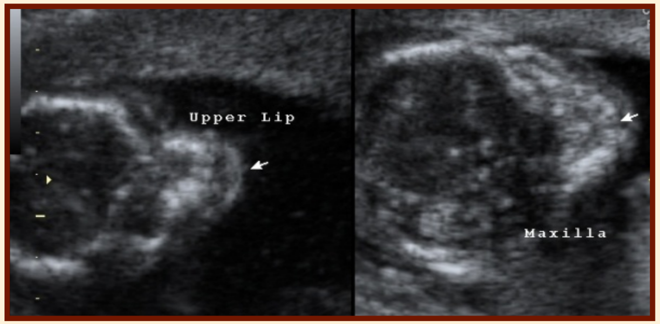


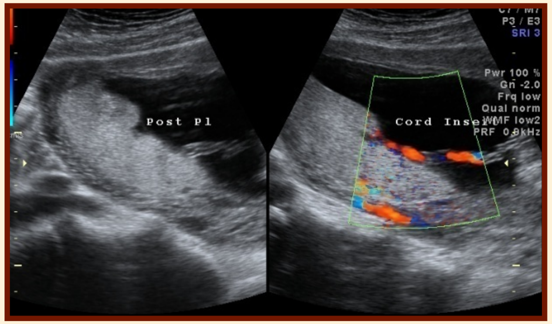
FETAL ANATOMIC ASSESSMENT IS FEASIBLE IN THE FIRST TRIMESTER…

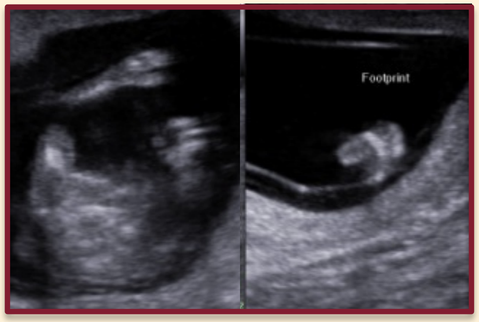
FULL ANATOMICAL SURVEY











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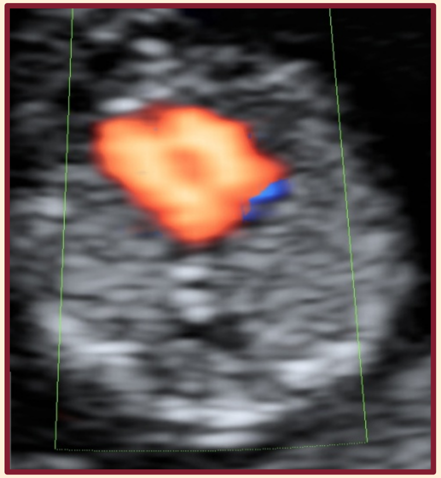
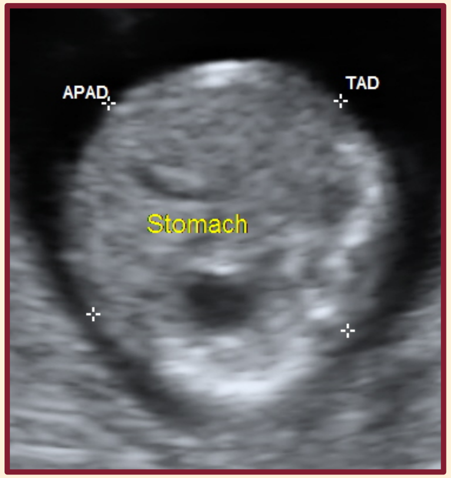
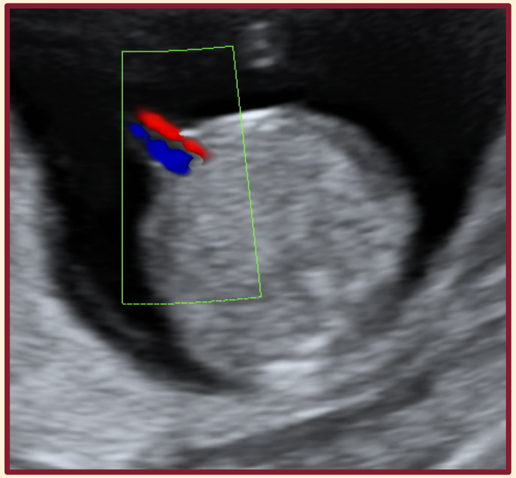
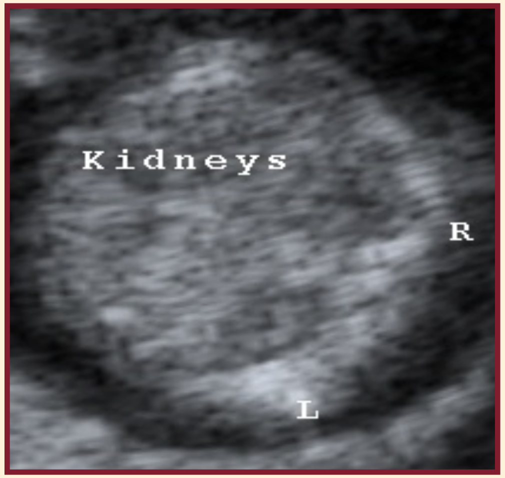
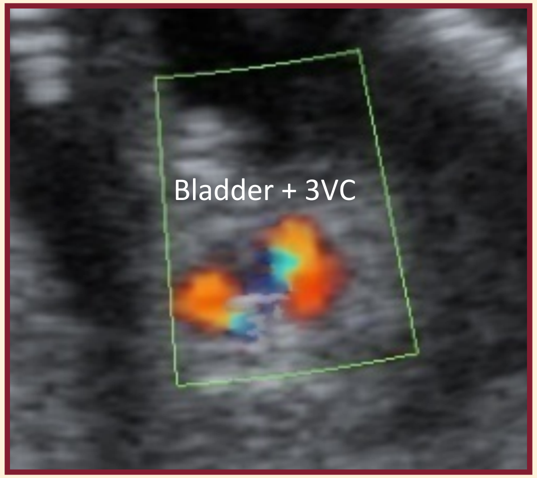


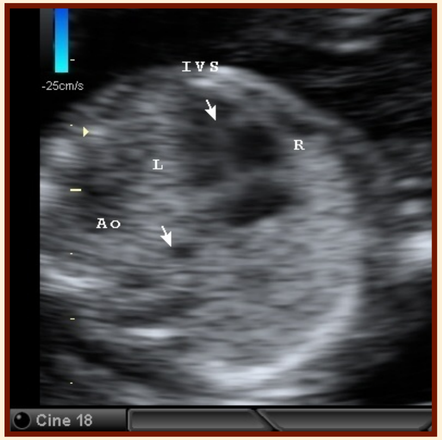


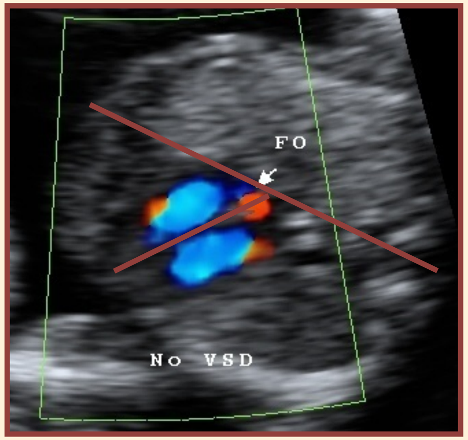


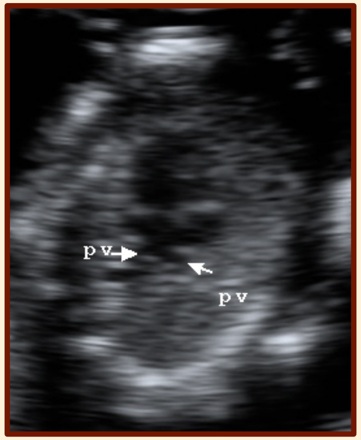


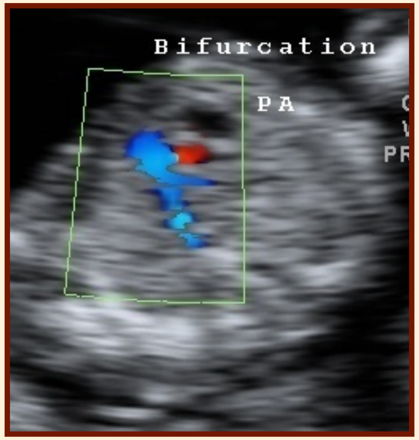


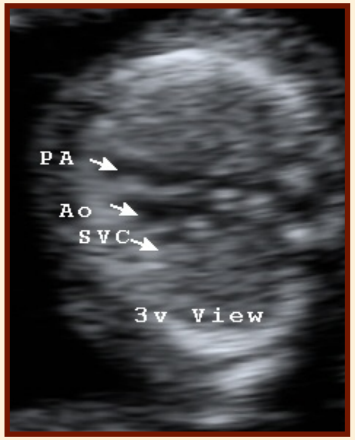
INCLUDING THE FETAL HEART…

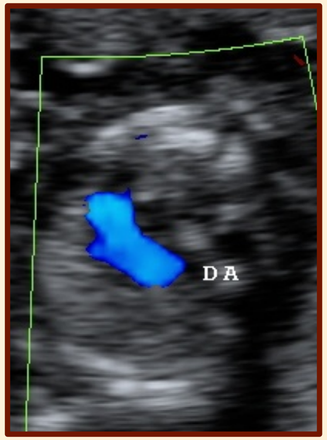


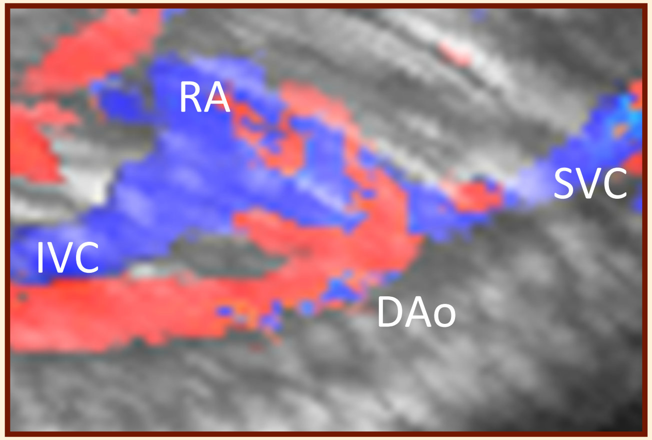


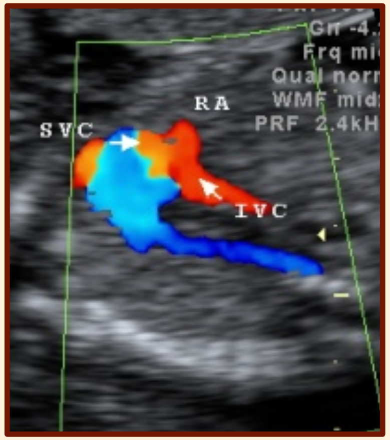




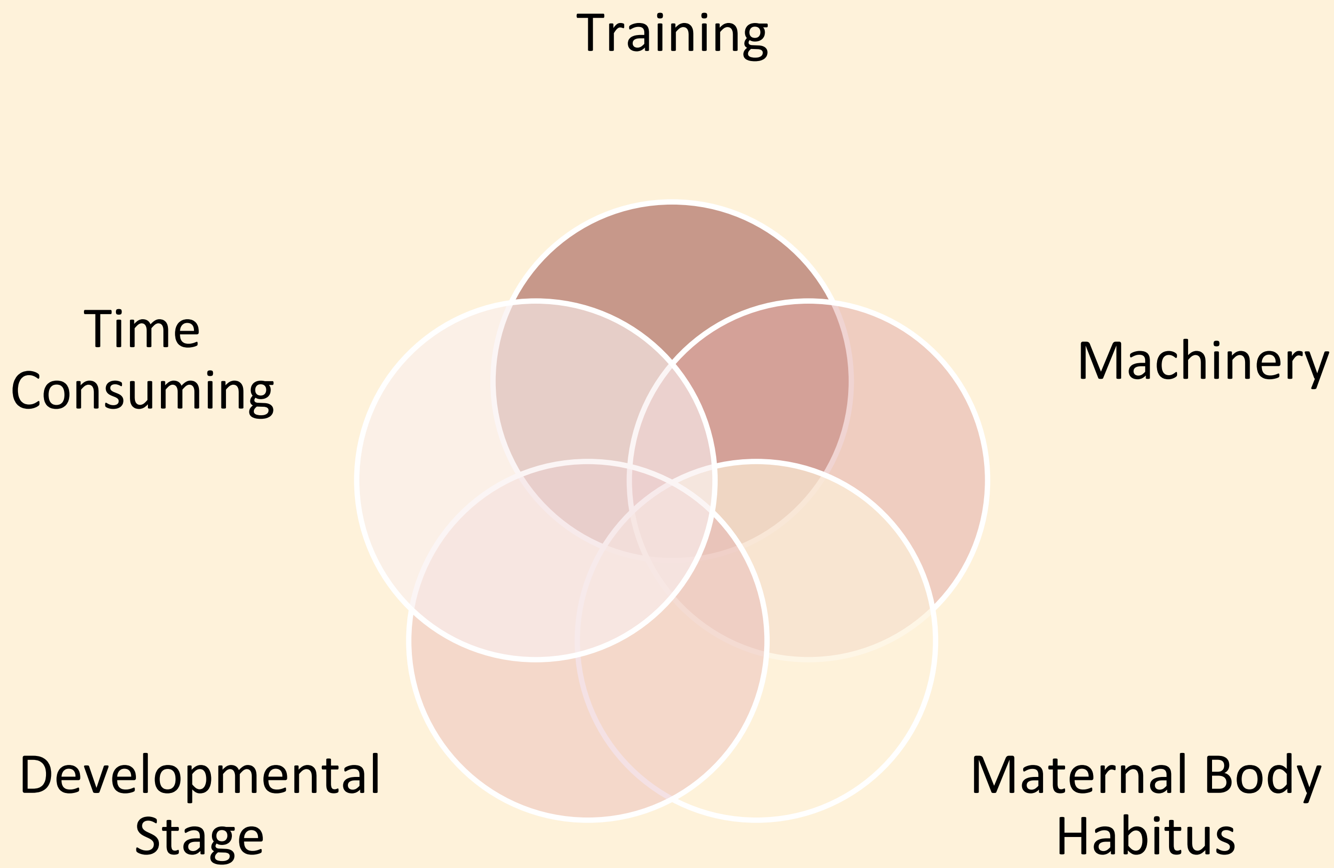






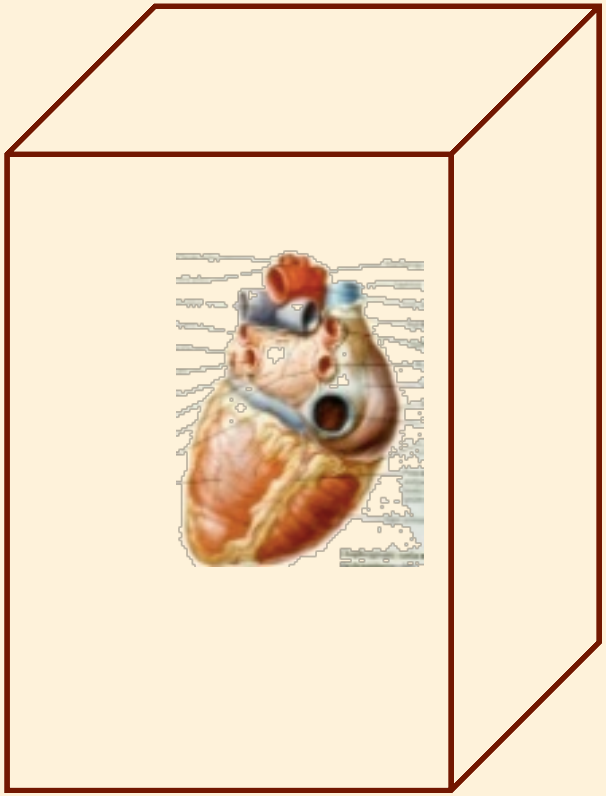


TECHNICAL/PERSONAL LIMITATIONS OF FTS



VOLUME SONOGRAPHY

- Acquired volume of a structure contains all the anatomical 2D planes for a complete evaluation of this structure
- For every organ, 2D anatomical planes that are needed for a complete evaluation are organized in a constant anatomic relationship to each other.
- **Standardization is KEY**



Abuhamad et al:
J Ultrasound Med 2005 24: 397, J Ultrasound Med 2007 26: 501, UOG 2008 31: 30

UNIQUE TO THE FIRST TRIMESTER

UNIQUE TO THE FIRST TRIMESTER

NOW WE GO TO NORTH LEBANON

OBJECTIVE

Objective

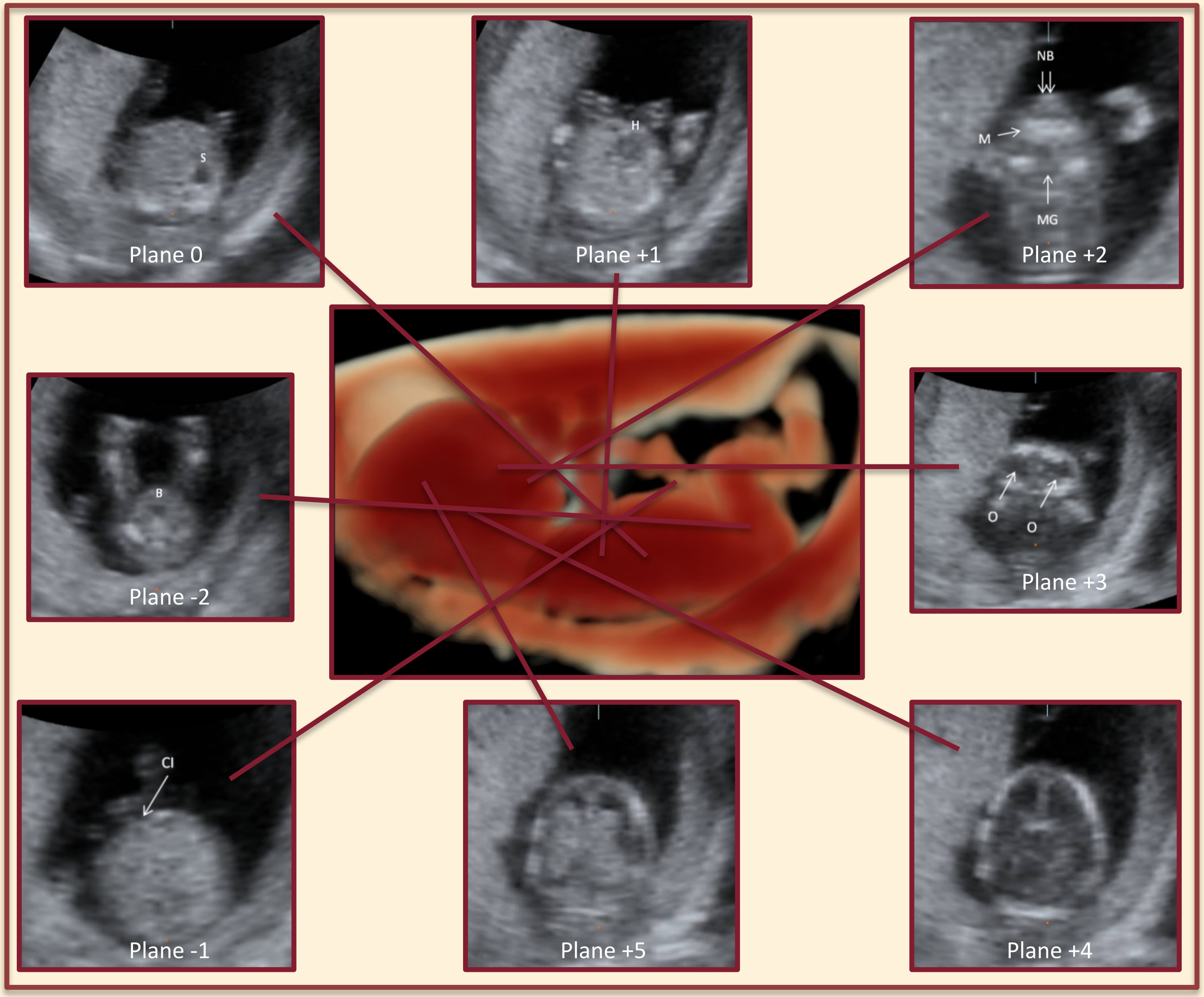
Our study aims at investigating the spatial relationships between 8 anatomic planes in the 11+6 - 13+6 week fetus.

METHODS

Methods

- Retrospective pilot study on 63 fetuses
- 8 anatomic planes retrieved from 3D/4D volume data
- Started from the mid-sagittal plane of the fetus
- Standardized and utilized the mid-sagittal volume (MSV) technique
- Spatial relationships between 8 anatomic planes were established
- The mean, median and the range were calculated for each of the planes, and they were evaluated as a function of the fetal crown rump length
- Non-parametric test, ANOVA, linear regression and step-wise multiple regression analysis were utilized
- P < 0.05 was considered statistically significant

METHODS:
MID-SAGITTAL VOLUME TECHNIQUE



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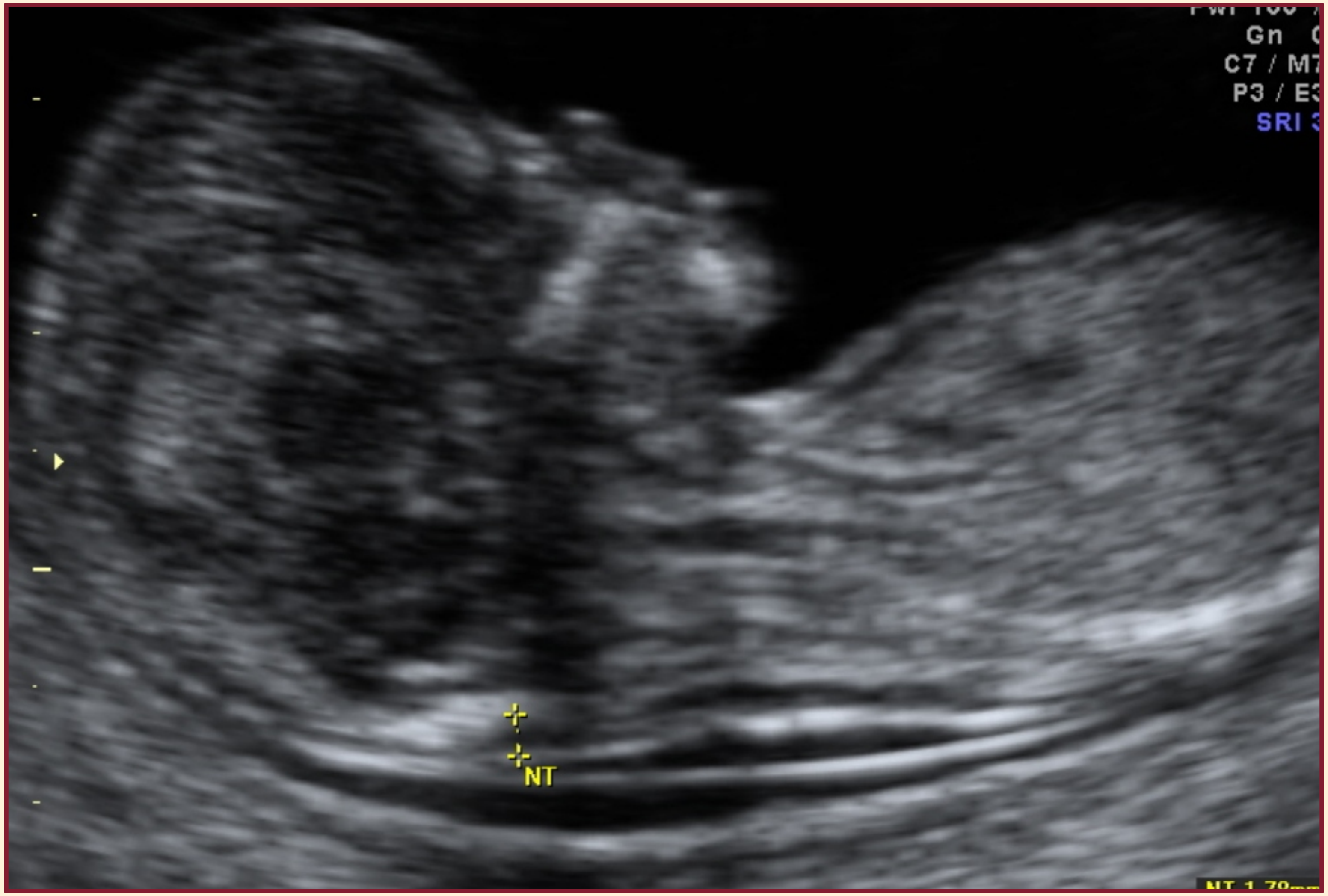

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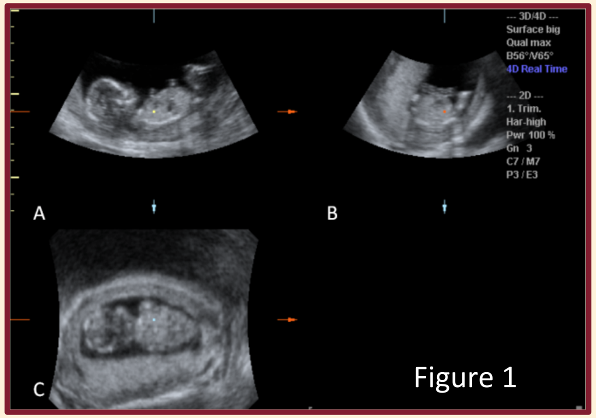

Figure 1

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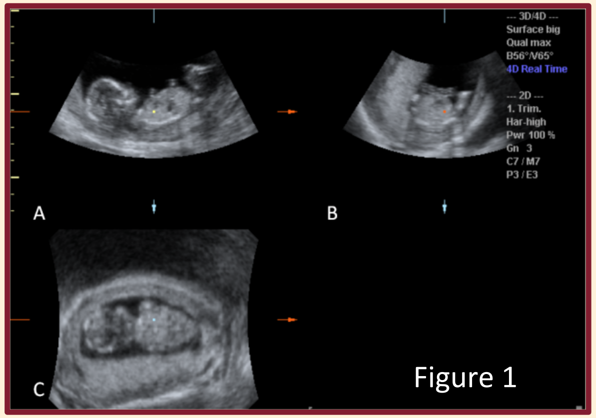

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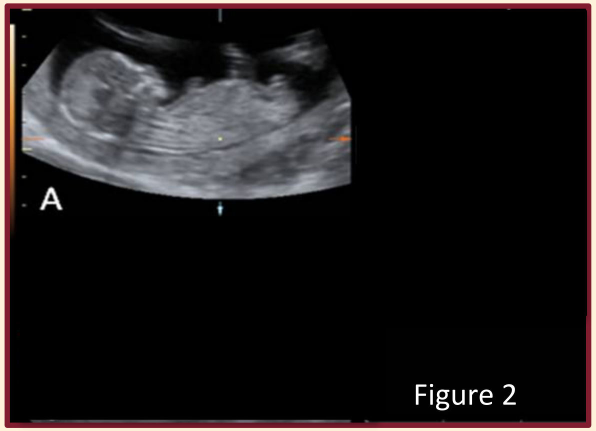

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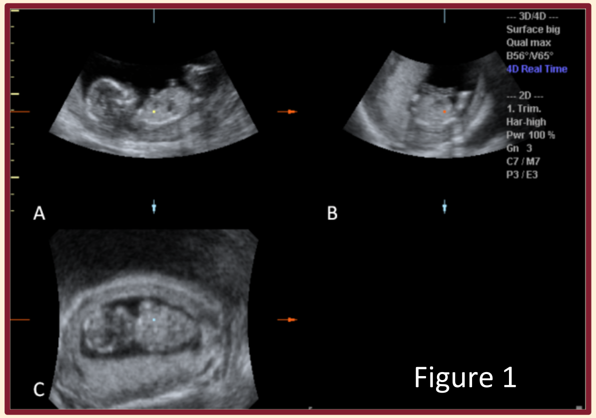

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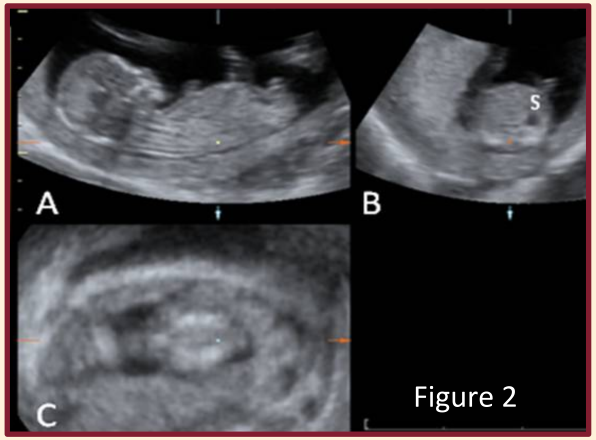

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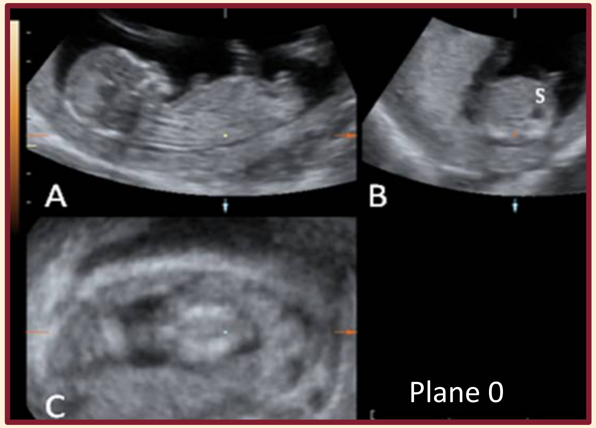

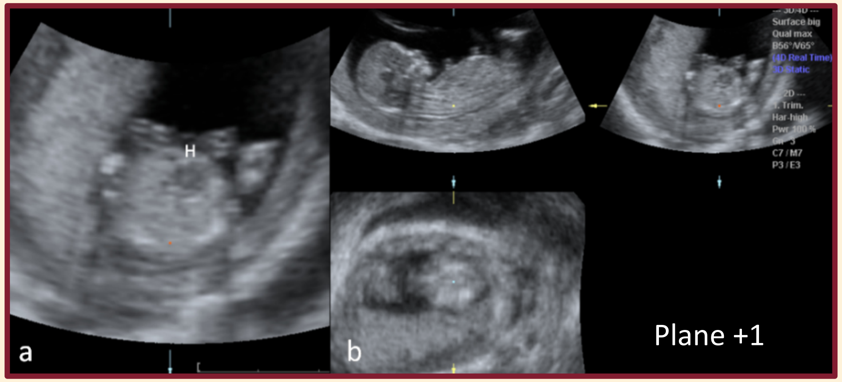

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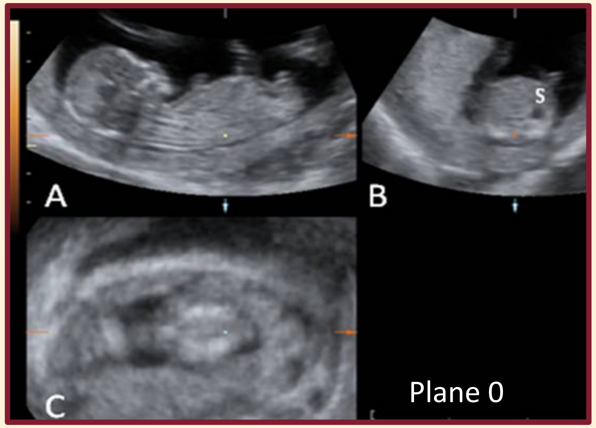

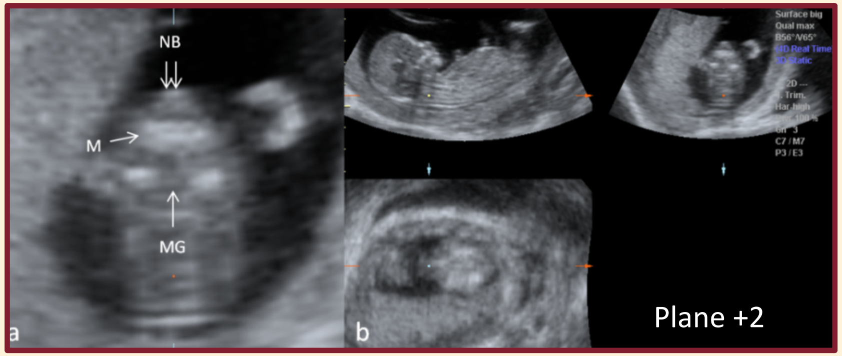

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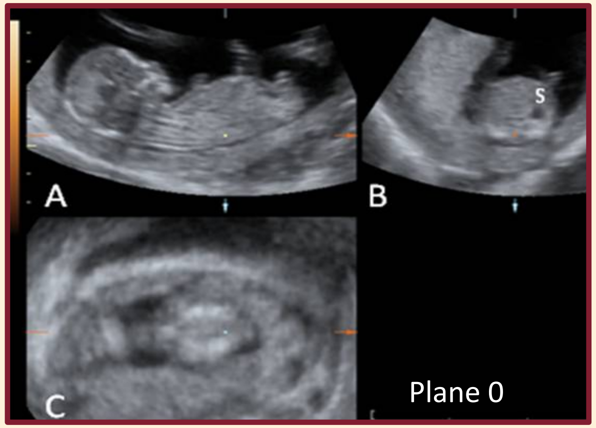

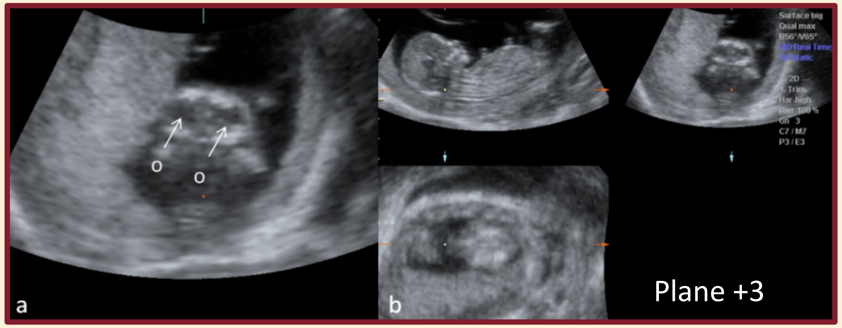

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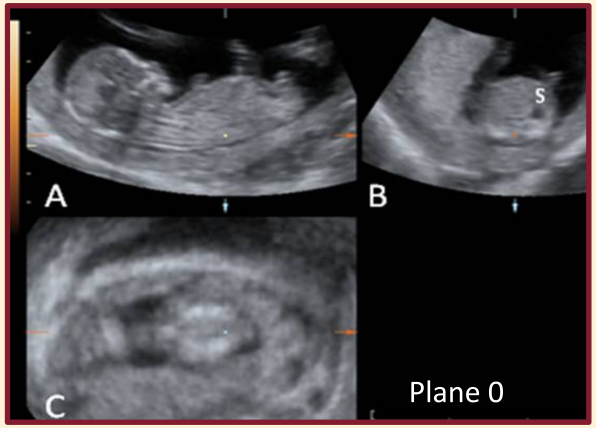

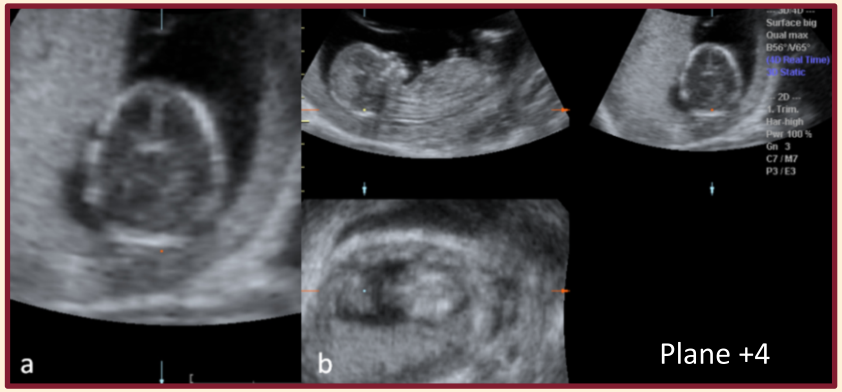

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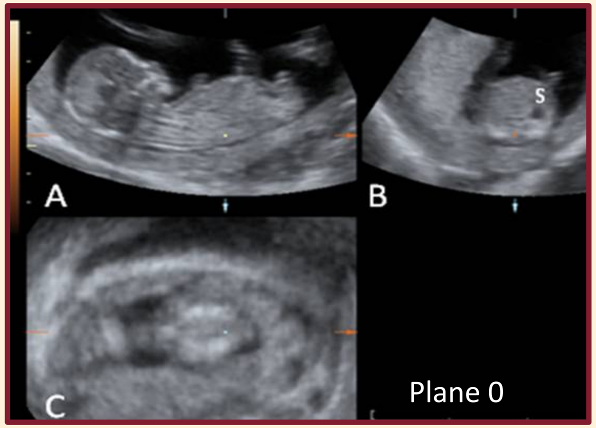

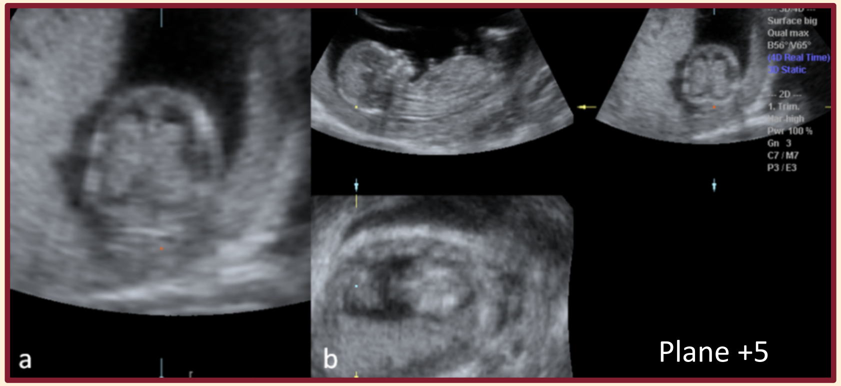

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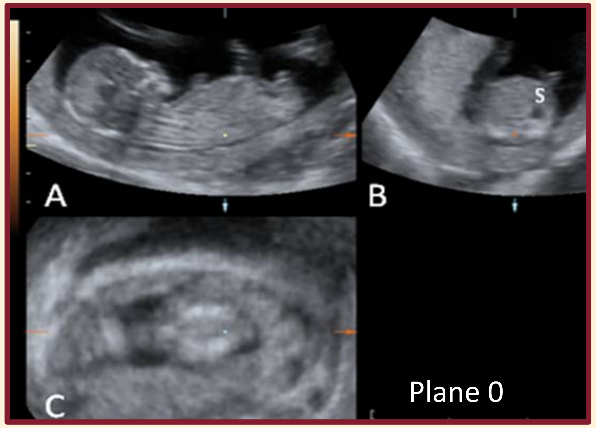

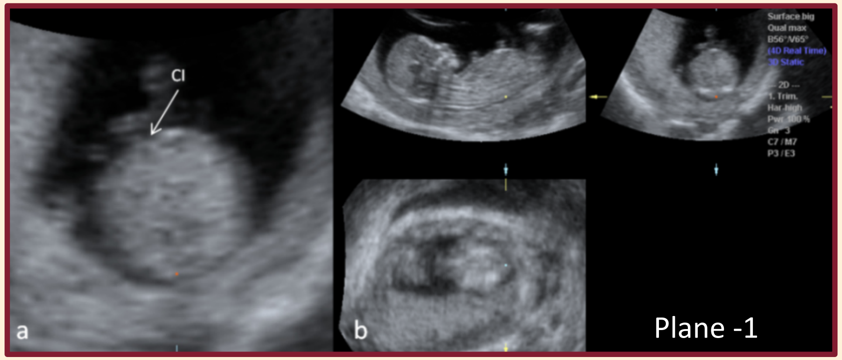

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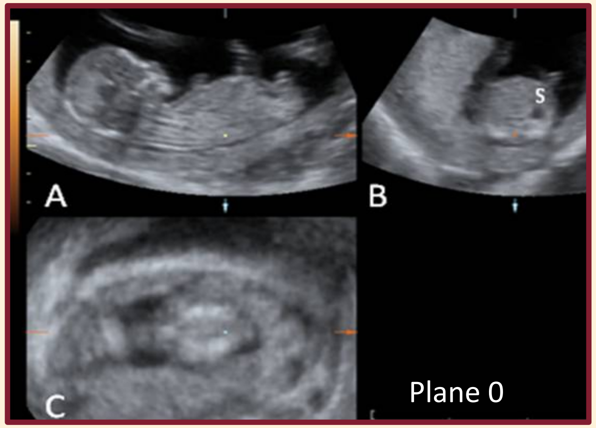
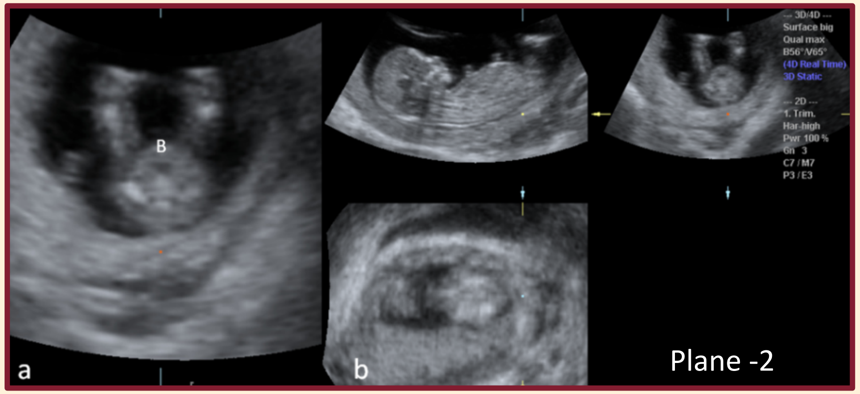




RESULTS:
USING THE MSV

Table 2 Total number of 2D planes retrieved out of the 63 volume data sets as a function of fetal CRL. Mean, minimum, maximum, and standard deviation (SD) are in millimeters. $P = 0.039$

# Planes retrieved	*N*	%	Mean CRL	SD	Minimum	Maximum
< 7 Planes retrieved	8	12.7%	66.1	8.6	52.4	75.5
7 Planes retrieved	19	30.2%	70.6	6.6	54.8	81.1
All 8 planes retrieved	36	57.1%	72.8	6.2	53.9	83.4
Total	63	100.0%	71.3	6.9	52.4	83.4

BMI < 25 (60.3%), 25-30 (31.8%) and > 30 (7.9%)

RESULTS: USING THE MSV

Table 3 **Percentage of successful retrieval of designated 2D planes out of the 63 stored sets, and descriptive statistics for the spatial relationships, expressed as percentage of the fetal CRL, cephalad (+) and caudad (–) from the transverse abdominal circumference plane (parallel shift) towards the seven 2D planes**

Plane	Total successful retrieval (%)	5%[a]	25%[a]	Mean, mm	75%[a]	95%[a]	Standard deviation
Plane +1	62 (98.4%)	5.37	7.08	8.27	9.46	11.17	1.76
Plane +2	49 (77.8%)	21.46	27.36	31.47	35.57	41.48	6.09
Plane +3	58 (92.1%)	24.74	31.03	35.41	39.78	46.07	6.49
Plane +4	60 (95.2%)	36.14	42.41	46.77	51.13	57.41	6.47
Plane +5	60 (95.2%)	42.48	49.02	53.57	58.11	64.65	6.74
Plane –1	50 (79.4%)	–15.16	–12.40	–10.48	–8.56	–5.80	2.84
Plane –2	61 (96.8%)	–23.91	–20.84	–18.72	–16.56	–13.49	3.17

All planes' measurements and CRL were tested for normality and were found to be normally distributed with *p*-values $>$ 0.138.

[a]On the basis of probability estimates, assuming normality and estimating the parameters (mean and standard deviation) from the data.

Plane 0: Abdominal Circumference; Plane +1: Heart; Plane +2: Facial Bones; Plane +3 Orbits; Plane +4: Biparietal Diameter; Plane +5: Butterfly; Plane; Plane -1: Cord Insertion; Plane -2: Bladder

RESULTS

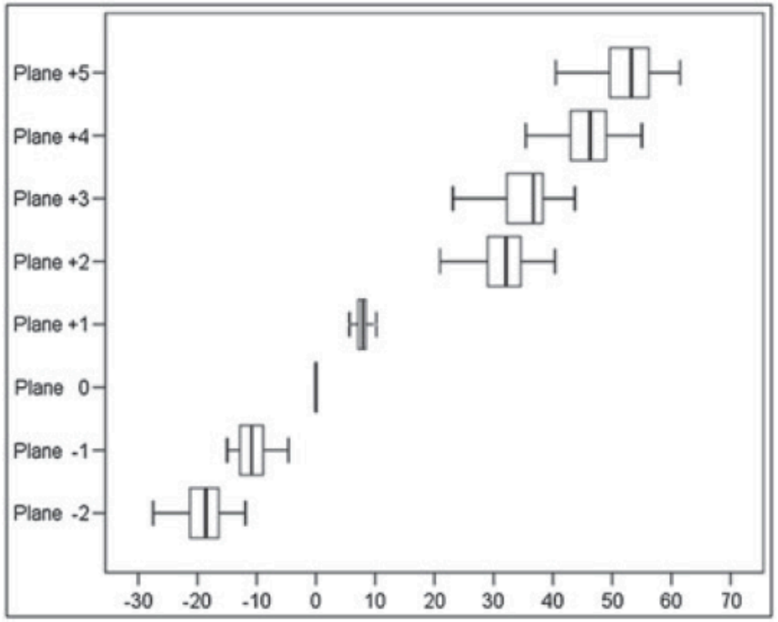
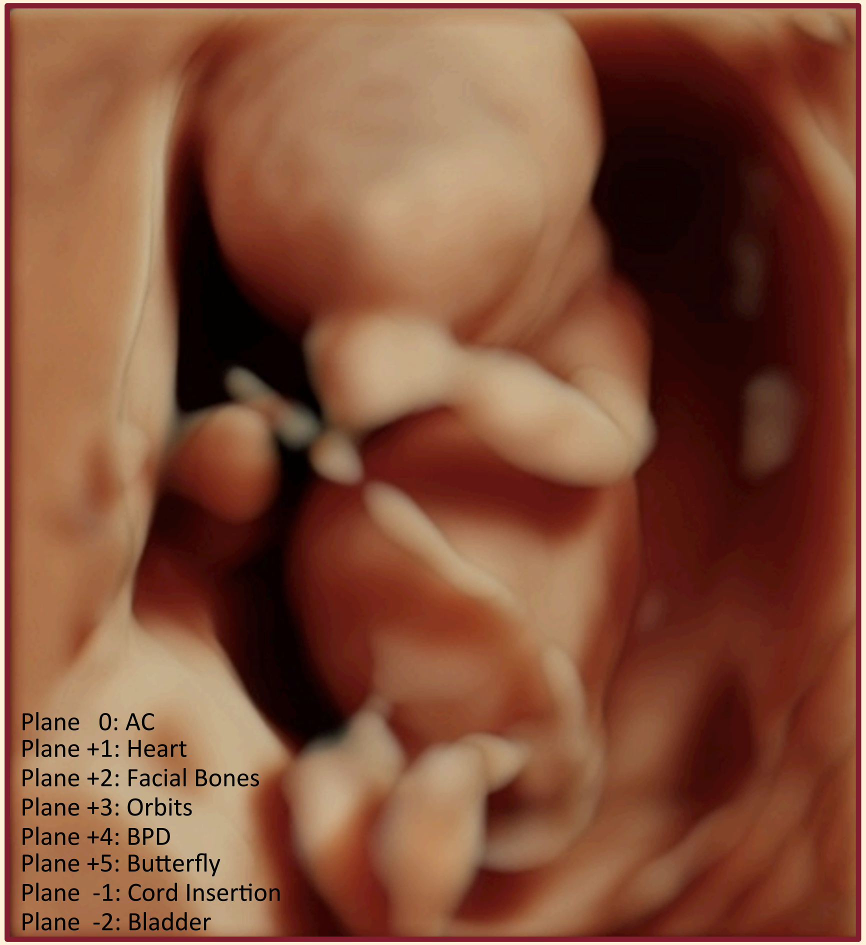


Figure 6 Figure 6 is a box plot representation for the parallel shift (in millimeters expressed as a percentage of each fetus' CRL) from plane 0 to all seven 2D planes. The line inside each box represents the 50th centile for CRL (median). The left and right edges of each box correspond to the 25th and 75th centiles, respectively. The end points of the left and right whiskers correspond to the minimum and maximum values



RESULTS

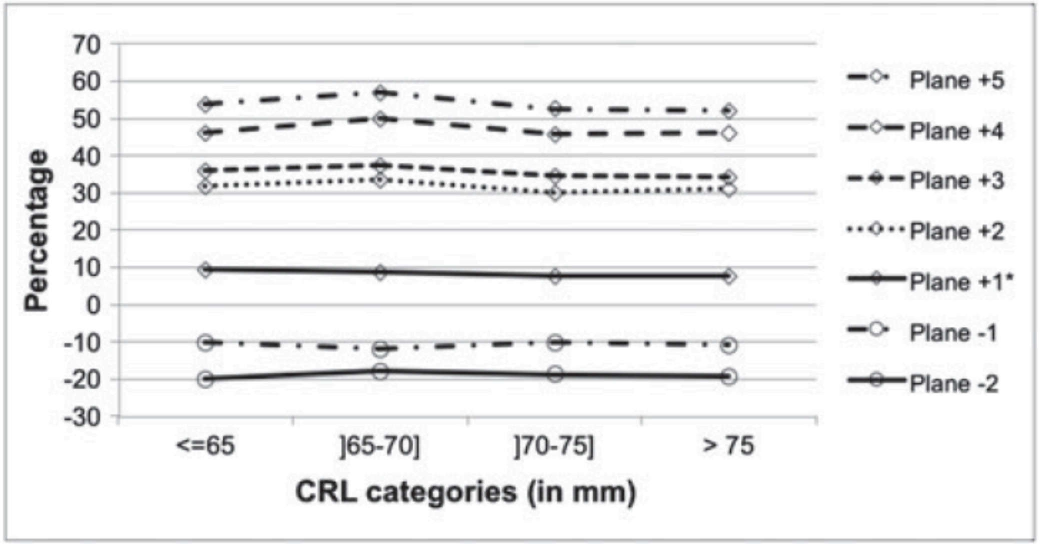


Figure 7 Figure 7 depicts the mean measurements of the distances from plane 0 to the five cranial and two caudal planes, expressed as a percentage of each fetus' CRL, as a function of fetal CRL categories. * Denotes the anatomic plane with statistical significance

Plane 0: Abdominal Circumference; Plane +1: Heart; Plane +2: Facial Bones; Plane +3 Orbits; Plane +4: Biparietal Diameter; Plane +5: Butterfly; Plane -1: Cord Insertion; Plane -2: Bladder

FUTURE DIRECTION...

FUTURE DIRECTION...

CONCLUSION

Limitations

- Sample size
- Retrospective nature
- Need larger prospective studies to validate

Conclusion

- To our knowledge, this is the first study to describe the possible spatial relationships between 8 two-dimensional anatomic planes in the 11+6 - 13+6 week fetus, utilizing a standardized approach, MSV
- The 8 anatomic planes were found to adhere to normal distribution curves
- Most of the planes are in a definable relationship to each other with statistically significant correlations
- Defining these spatial relationships may serve as the first step for the potential future development of automation software for fetal anatomic assessment at 11+6 - 13+6 weeks

THANK YOU!


Beyond the Shadow of Any Doubt...
...the future of ultrasound is so incredibly bright...