

# Quantitative evaluation of factors influencing the successful acquisition and quality of 3D obstetric ultrasound images through a retrospective analysis of 3D fetal facial scans



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## 1. BACKGROUND and AIMS

Three-dimensional (3D) prenatal ultrasound scans of a baby's facial features are increasingly popular in private practice and there is an emerging role in clinical practice. However, prospective parents are often disappointed with the quality of images obtained. The aim of this study was to explore the impact of maternal-fetal factors on image quality and evaluate scanning strategies that result in optimal 3D facial imaging

## 2. METHODS

Retrospective review of 3D surface rendered ultrasound images acquired from pregnant women as souvenir images as part of a research study REC: 14/LO/1806.

- The overall clarity of each image for facial visualisation was scored from 0 (unidentifiable) to 3 (good) using an in-house scoring system. See Fig 1.
- Two sonographers reviewed the images independently using the scoring system.
- Rater agreement between experienced sonographers was assessed using Cohen's kappa test.
- Maternal and fetal factors affecting visualisation of the fetal face explored using Chi-squared tests, analysis of variance (ANOVA) test and a logistic regression model were then used to explore factors influencing image quality.



**GOOD**  
More than 75% of profile seen, not obscured by overlying structures such as limbs, umbilical cord, motion artefact.

**MODERATE**  
50- 75% of profile not obscured by overlying structures such as limbs, umbilical cord, motion artefact.

**POOR**  
Less than 50% of profile not obscured by overlying structures such as limbs, umbilical cord, motion artefact.

**FAIL**  
No identifiable features distinguishable

Figure 1. In house scoring system developed for assessing the quality of visualisation of fetal facial features.

## 3. RESULTS

### 3.1 Participants

Images were analysed from 41 women (total 342 images, Gestational Age range 21-30 years, BMI 19-37.5 kg/m<sup>2</sup>). Data on uterine-Fetal Amniotic Assessment (UFAA), placental site, fetal parts obscuring face and fetal position are summarised in Table 1.

Table 1. Participant demographics.

Maternal-Fetal Characteristics	N (%)
<b>(UFAA)</b>	
Good	149 ( 47%)
Moderate	114 ( 36%)
Poor	51 (16%)
<b>Placenta Position</b>	
Anterior	160 (51%)
Posterior	145 (46%)
Fundal	9 (2.9%)

Maternal-Fetal Characteristics	N (%)
<b>Fetal Position</b>	
Cephalic supine	78 (24%)
Cephalic prone	10 (3%)
Cephalic lay on rt/lt side	118 (37%)
Breech supine	42 (13%)
Breech prone	22 (7%)
Breech lay on rt/lt side	30 (9.6%)
Transverse	14 (4.5%)
<b>Fetal parts</b>	
none	74 (23.6%)
limbs	76 (24.2%)
cord	26 (8.3%)
both	81 (25.8%)
placenta	57 (18.2%)

### 3.2 Quality of fetal face visualisation

Only 3% of scans were scored as good. Rating scores are summarised graphically below. The rating by two obstetric sonographers showed moderate agreement, Cohen's Kappa = 0.516, p <0.001.

Score %

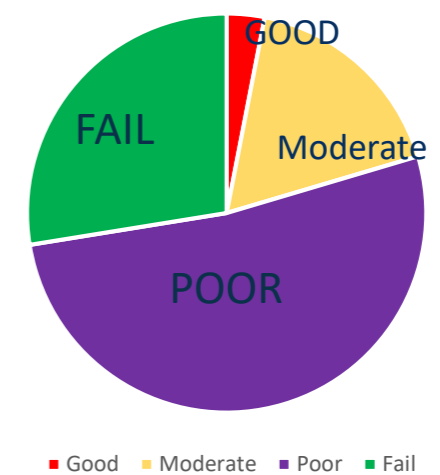
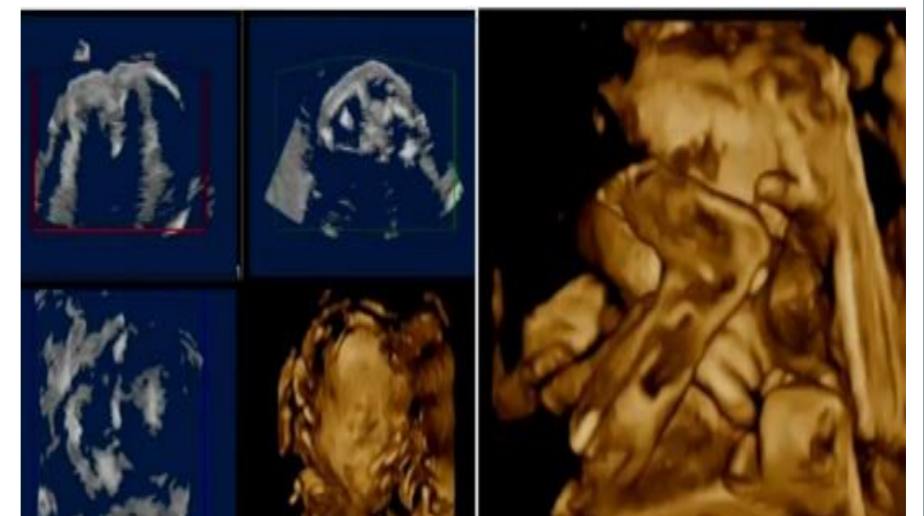


Figure 2. Sonographer assessment of the quality of fetal face visualization based on 314 3D obstetrics facial views.

### 3.3 Maternal and imaging factors affecting fetal face visualisation

Figure 3. Fetal motion artefact (left image) and bony structures obscuring face (right image)



Statistically significant factors affecting image quality on a Chi-squared test included gestational age, Uterine-Fetal Amniotic Assessment (UFAA), placental site, fetal parts obscuring face (see e.g. Fig. 3), maternal age, and fetal position (p<0.05).

Multiple logistic regression model suggested that the factors namely; fetal parts obscuring face, UFAA, fetal position and placental site in combination also produced the best quality images (p<0.05). The remaining factors of gestational age and maternal age did not have a significant impact on quality in this sample.

**Strengths and limitations:** The limitations of the present study are its retrospective nature, the small sample of 41 cases, limited ethnic demographics of mothers, and smaller BMI range in comparisons to earlier larger studies featuring more ethnically diverse populations. Strengths included a robust study design .

## 4. CONCLUSIONS

These results reinforce findings of previous researchers that sufficient amniotic fluid, fetal position, overlying structures and placenta position are major factors in 3D ultrasound facial examination. Even if all factors are favourable at the time of scan, any movement of the fetus is out of the control of the sonographer and can lead to reduced image quality. Only 3% of images in this study clearly showed more than 75% of the fetal face.

- Women should be made aware of the limitations of visualisation and the problems caused by fetal position, UFAA, structures overlying face and placental site.

### Conclusion:

- Good amniotic fluid level around the face, cephalic fetal position, lack of obscuring fetal parts and posterior placenta are positive factors influencing the image quality of 3D obstetric facial views

## REFERENCES

- Merz, E., & Pashaj, S. (2017a). Advantages of 3D ultrasound in the assessment of fetal abnormalities [Article]. *Journal of Perinatal Medicine*, 45(6), 643–650.