Obtaining first trimester 2D anatomical views with the aid of 3D Ultrasound.

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Introduction

Key anatomical structures should be examined at the first trimester scan (at 11-14 weeks gestation) in addition to the crown rump length and nuchal translucency.

Examining key structures enables conditions such as acrania and exomphalos to be detected.

It can be time consuming to obtain individual images if a fetus is in a sub optimal position. One 3D volume is often able to provide many of these images in a fraction of the time.

Obtaining 2D images from a 3D volume dataset

A 3D ultrasound volume dataset is made up of a series of 2D images. The 2D image used at the start of the 3D volume will be the central image of the volume. It is crucial to ensure that this start image is of adequate quality, with the standard CRL plane being desirable. The operator selects the area to be included using a region of interest box, acquisition then occurs by sweeping from one margin of the box to the other, with everything within displayed in 3D. The acquisition is displayed in real time allowing the operator to halt the 3D sweep if there is fetal movement or it does not appear to be of adequate quality.

Representation of a 2D image stack

Objective

To assess whether fetal anatomy can be examined using 2D image slices extracted from a 3D volume taken at 11-14 weeks gestation.

Method

Prospective observational study of women attending a routine first trimester ultrasound scan between November 2021 and April 2022. A routine 2D first trimester scan was performed, followed by a 3D volume of the entire fetus, starting in the sagittal plane. If successfully obtained, the 3D volume was uploaded to GE 4D view software.

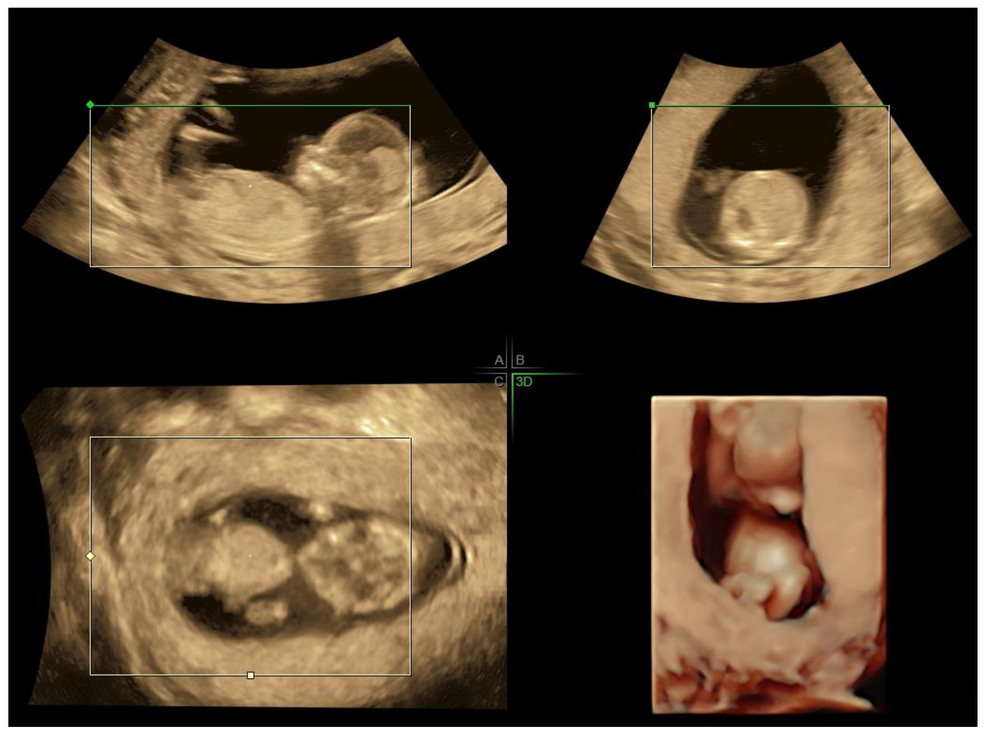
Each 3D volume was examined in multiplanar view to assess whether 2D images of diagnostic quality could be extracted for the axial head, facial profile, stomach, cord insertion, bladder, bilateral hands and feet, crown-rump length (CRL) and nuchal translucency (NT).

Results

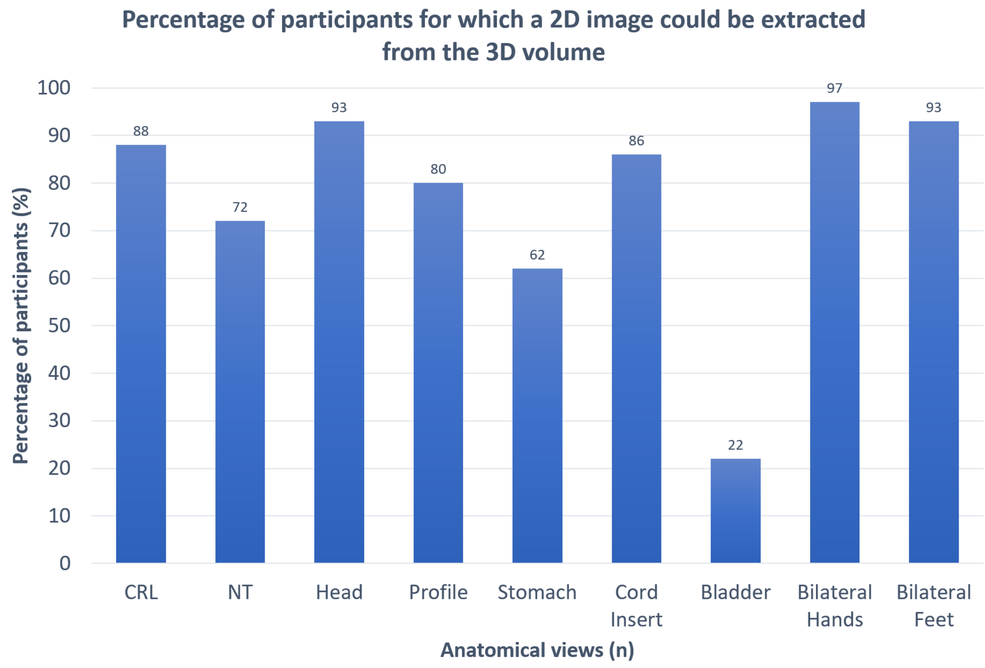
81 participants were prospectively recruited. A successful 3D volume was obtained for 94% of participants.

By adjusting the axis of the 2D view we have been able to gain diagnostic views for most of the examinations that have been reviewed. This was often still achievable even with 3D images that initially seemed to be poor due to fetal position. It was possible to diagnostically evaluate the following structures using only the 2D image slices obtained from the 3D volume:

CRL (88%), NT (72%), head (93%), facial profile (80%), stomach (62%), cord insertion (86%), bladder (22%) bilateral hands (97%), bilateral feet (93%).



A 3D volume taken on a Voluson E8 showing sagittal, axial and coronal planes



Conclusions

- A single 3D volume has the potential to provide information on key anatomical structures within minutes.
- With appropriate training, extraction of 2D images from this volume at 11-14 weeks allows evaluation of major anatomical structures in the first trimester, reducing time pressures on ultrasound departments, and may provide additional benefit in reducing the rate of repetitive strain injuries for sonographers.
- Future studies should aim at optimising 3D acquisition, taking into account more difficult to extract anatomies; and examine whether this could be a useful alternative to 2D imaging rather than an adjunct.

2D images extracted from a 3D volume

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