THREE-DIMENSIONAL DISPLAY OF FETUS, PLACENTA AND UTERUS USING AN ULTRASONIC COMPUTER MODELLING SYSTEM

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J.F. Brinkley, W.D. McCallum, S. Muramatsu
Dept. Gynecology and Obstetrics
Stanford University

A computer based system has been developed for three-dimensional display and calculation of organ volumes [1]. We have used the system to obtain computer models of the fetus, uterus and placenta which can be displayed on a graphics terminal. The method involves the collection of a series of arbitrarily oriented real time ultrasound scans throughout the organ of interest. The scans are related to each other in three dimensions by means of an acoustic position locating system which allows nearly complete freedom of motion of the scan head [2]. A light pen is used to outline the borders of the organ, and a computer is used to combine the position and outline information into a three-dimensional model. The models are used to find volume and to generate three-dimensional displays.

The computer plots shown in this abstract were obtained as follows. At the beginning of the patient exam a coordinate system was established by using the locating system to indicate 3 points on the abdomen (the xiphoid, pubic symphysis, and left anterior iliac spine). This patient coordinate system allowed the subsequent reconstructions to be displayed in terms of known anatomical landmarks. A Toshiba linear array scanner was then used to collect a series of scans of the uterus, placenta, fetal head and fetal trunk. The scans were recorded on a video tape recorder, and the corresponding three-dimensional positions were recorded on a computer disk. During this time the patient was required to remain motionless (about 5 minutes). At a later time the scans were recalled from the tape recorder, outlined with a light pen and sent to a larger computer for subsequent analysis and display.

The figures are from a 17 week pregnancy. The upper series of outlines represents the original boundaries of the placenta and uterus. The scans were arbitrarily oriented, and in general were only partially complete since the entire uterus would not fit on any one real time scan. The lower display shows the computer models. The models were fitted separately to the uterus and placenta and then combined by the computer into a single plot. The models are shown in terms of the patient coordinate system: the origin is the pubic symphysis, the point "C" is the left anterior iliac spine. Additional examples of three-dimensional reconstructions will be presented.

We are currently studying the effectiveness of these models in predicting fetal volume and weight from head and trunk reconstructions. We hope that by using three-dimensional information more accurate results can be obtained than have been possible with individual or combinations of ultrasonic measurements [3].
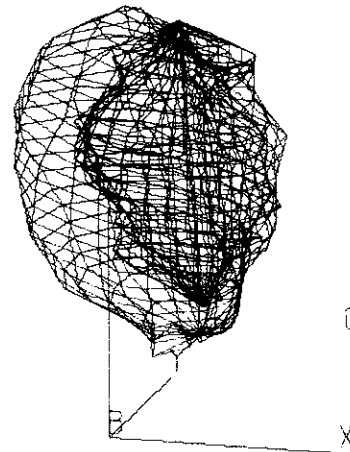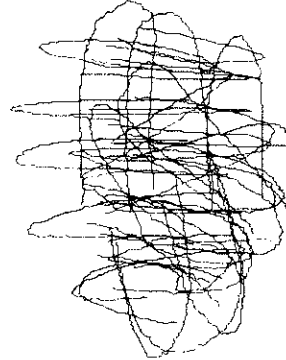
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Dept. Gynecology and Obstetrics
Stanford University School of Medicine
Stanford, Calif., 94305