**Introduction**

MVCs involving pregnant mothers are reported as causing an estimated 1500–5000 fetal losses each year in the United States [1]. In the latter stages of pregnancy, the gravid fetus causes the mother’s abdomen to protrude from her body, and this makes the abdomen susceptible to trauma during an MVC. Common injuries to a pregnant female after a MVC include: excessive bleeding, placental abruption, uterine rupture, and premature delivery [2]. The most common fatal injury for the fetus when the mother survives blunt force trauma, such as that sometimes experienced in an MVC, is abruptio placentae [3]. This is caused by a shear effect between the placenta and the uterus during rapid impact and deceleration. Often, this injury is not evident until it is too late to save the fetus [4].

**Methods**

A scan most representative of a fifth percentile female in the early 3rd trimester with a healthy fetus and no abdominal injury was selected for analysis from available abdominal computed tomography (CT) scans taken over the past ten years at Wake Forest University Baptist Hospital. Scans were imported into Mimics (Materialise Software, Ann Arbor, MI) for image segmentation. Using Hounsfield unit threshold values and manual segmentation, the slices were segmented to create masks of each abdominal organ and the fetus. The uterus and placenta masks were created by also using Boolean operations, which subtracted one mask from another. This ensured a proper fit along the placental-uterine interface.

**Results**

The average gestational age predicted by fetal measurements using literature data is 32.2 weeks as shown in Figure 3.

**Discussion**

Gestational age estimations are usually made from the brain and skull anatomy using ultrasound [10]. Using CT, it was difficult to locate the specific brain landmarks where these skull measurements were to be taken because of slice spacing and resolution of ultrasound. The measurements were compared with data found in the literature values and estimated the fetus to be approximately 32 weeks gestation which agrees with the emergency department reported medical record listing the female to be 32 weeks pregnant. At this stage of gestation, clinicians estimate that all gestational approximations are ±3 weeks accuracy. While the skin, fat, and maternal skeletal volumes and measurements will differ for all females, the organ size and uterus, placenta, and fetus sizes are relatively consistent for pregnant females. The size of the uterus in the 3rd trimester is determined by the size of the fetus, not the size of the mother. This makes these organ volumes applicable for primarily all pregnant females, independent of body shape. There are, however, some limitations to this study because it only utilized one pregnant female. While it is common for the placental attachment point to be at the fundus, other placental locations and individual anatomical differences will create different results. Additional studies at different gestational times would also be useful in creating multiple pregnant models for testing, but the 3rd trimester pregnant female was chosen to obtain geometry in a more distended state.

In the future, further studies using a larger group count could validate the results of this study. The average uterus area for each slice could be calculated and used to create an accurate representation of the amount of amniotic fluid that is present. This could then be incorporated into the pregnant female model to predict how the amount of incompressible fluid within the uterus affects the fetus during blunt force trauma. After creating an accurate model of the uterus-placenta attachment, it may be possible to predict where abortion will occur by looking at thin points in the uterine wall and thick areas of the placenta. This prediction technique would also be helpful in formulating fetal injury criteria independent of maternal injuries.

**References**


