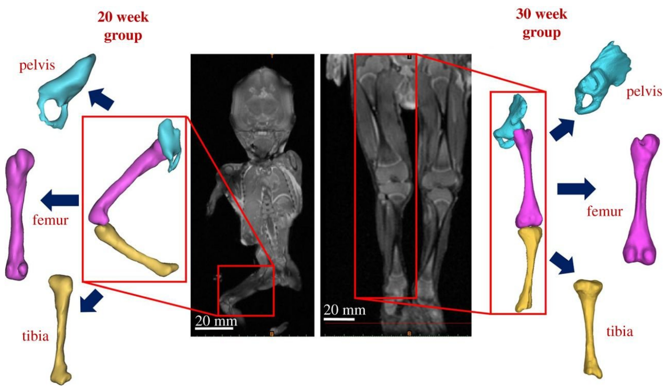
# Monitoring fetal movements helps detect musculoskeletal malformations

24 January 2018, by Bob Yirka




Fetal geometries obtained from post-mortem MRI. Post-mortem MRI scans at 20 and 30 weeks' gestational age allow three-dimensional reconstruction of both mineralized and cartilaginous components of the pelvis, femur and tibia. Credit: *Journal of the Royal Society Interface* (2018). Published 24 January 2018. DOI: 10.1098/rsif.2017.0593

A team of researchers with Imperial College London and Great Ormond Street Hospital, both in the U.K., has found that monitoring fetal movements in pregnant women can help in detecting fetal musculoskeletal malformations. In their paper published in the *Journal of the Royal Society Interface,* they describe their computer analysis of MRI scans to create models that depict fetal movement, which allowed them to track such movements in fetuses from 20 to 35 weeks, and what they found by doing so.

A kicking baby is one of the milestones of a healthy pregnancy, but as the researchers note, few investigations have been conducted into what actually occurs in the womb as the fetus grows and begins moving around. To learn more, the researchers analyzed MRI scans from patients at Great Ormond Street Hospital, which allowed them to create models of fetal movement. The models produced animated representations of a fetus inside the uterus as it stretched, kicked and moved in other ways, allowing the team to track how much force the fetus was exerting on its environment.

The researchers found that a fetus is able to exert up to 4 kilograms of force against the walls of the uterus at around 30 weeks, the peak time for fetal activity. After that, fetal force was reduced as the fetus found itself with less room to maneuver due to its increasing size. The team also found that kicking was a form of exercise, helping the growing fetus develop proper muscle and bone structures. They also found that even after the fetus had reduced room for movement, fetal kicking was still important because the stress helped leg and arm joints to develop properly. Taken altogether, the researchers report that fetal movement is critical for normal development of bones and joints. These last findings proved to be particularly useful, the team notes, because a lack of movement, whether kicking or otherwise, could predict musculoskeletal malformations after birth. Developing tools to measure kick force within the womb could help doctors prepare the proper care for babies after birth.

**More information:** Stresses and strains on the human fetal skeleton during development, *Journal of the Royal Society Interface* (2018). Published 24 January 2018. DOI: 10.1098/rsif.2017.0593

**Abstract**
Mechanical forces generated by fetal kicks and movements result in stimulation of the fetal skeleton in the form of stress and strain. This stimulation is known to be critical for prenatal musculoskeletal development; indeed, abnormal or absent movements have been implicated in multiple congenital disorders. However, the mechanical stress and strain experienced by the developing human skeleton in utero have never before been characterized. Here, we quantify the biomechanics of fetal movements during the second half of gestation by modelling fetal

movements captured using novel cine-magnetic resonance imaging technology. By tracking these movements, quantifying fetal kick and muscle forces, and applying them to three-dimensional geometries of the fetal skeleton, we test the hypothesis that stress and strain change over ontogeny. We find that fetal kick force increases significantly from 20 to 30 weeks' gestation, before decreasing towards term. However, stress and strain in the fetal skeleton rises significantly over the latter half of gestation. This increasing trend with gestational age is important because changes in fetal movement patterns in late pregnancy have been linked to poor fetal outcomes and musculoskeletal malformations. This research represents the first quantification of kick force and mechanical stress and strain due to fetal movements in the human skeleton in utero, thus advancing our understanding of the biomechanical environment of the uterus. Further, by revealing a potential link between fetal biomechanics and skeletal malformations, our work will stimulate future research in tissue engineering and mechanobiology.



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