Movement in the womb sparks specific genes to build a healthy skeleton

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(Phys.org) —Zoologists and bioengineers from Trinity College Dublin have identified over 1,000 genes whose responses change markedly when embryos are not able to move freely in the womb. The discovery will help scientists better understand how important tissues are programmed to develop in our bodies, which could in turn suggest how stem cells can be primed for use in tissue engineering and regenerative therapies.

The collaborative research conducted in the School of Natural Sciences and Trinity Centre for Bioengineering is addressing how embryonic movement influences bone and joint development. This research also furthers understanding of the consequences of reduced movement and shows how we might guide desired differentiation of bone and cartilage from stem cells.

"Why do babies move about so much while they are developing in the womb, particularly flexing their arms and legs? We know that if they don't move enough, they are born with skeletal problems such as thin, fragile bones," said Developmental Biologist and Associate Professor in Zoology, Paula Murphy, who is the senior author of the study.

"Highly regulated signalling systems are needed for Mother Nature to follow the complex 'recipes' of genetic expression that enable the development of normal skeletons. What often surprises people is that mechanical signals also feed in to these signalling systems, and it is the movement of an embryo that sparks these."

By studying how animals move and develop, the zoologists and bioengineers have pin-pointed which steps during skeleton formation require stimulation from movement. Additionally, by examining the patterns of all the genes in the genome, they have shown which specific genes and molecules are stimulated by movement.

Very little is known about how the mechanical signals are integrated into the biochemical signalling pathways. That could soon change, however, as these researchers home in on the 1,000-plus genes whose responses changed in mouse embryos that lacked muscles and therefore did not kick during development.

The research, just published in the leading journal *BMC Genomics*, featured Research Fellow at Trinity, Rebecca Rolfe, as the first author. It highlighted a number of genes already known to encode regulatory molecules that guide developmental decisions in the embryo. It also highlighted genes that are involved in controlling cell shape changes and in aiding cell-to-cell communication. In particular, the research highlighted the 'Wnt' pathway, which passes signals from the exterior to the interior of specific cells, as a potential point of integration of mechanical and molecular signalling.

"If we can better understand the signalling processes involved, we might guide development of stable bone and cartilage tissues for use in regenerative therapies. We are now working to fill in the gaps in our knowledge around the combinations of mechanical and molecular signals that are needed to guide differentiation of stem cells for this purpose," added Associate Professor Murphy.

More information: See the full study here: www.biomedcentral.com/1471-2164/15/48

Provided by Trinity College Dublin