How the early embryo changes shape

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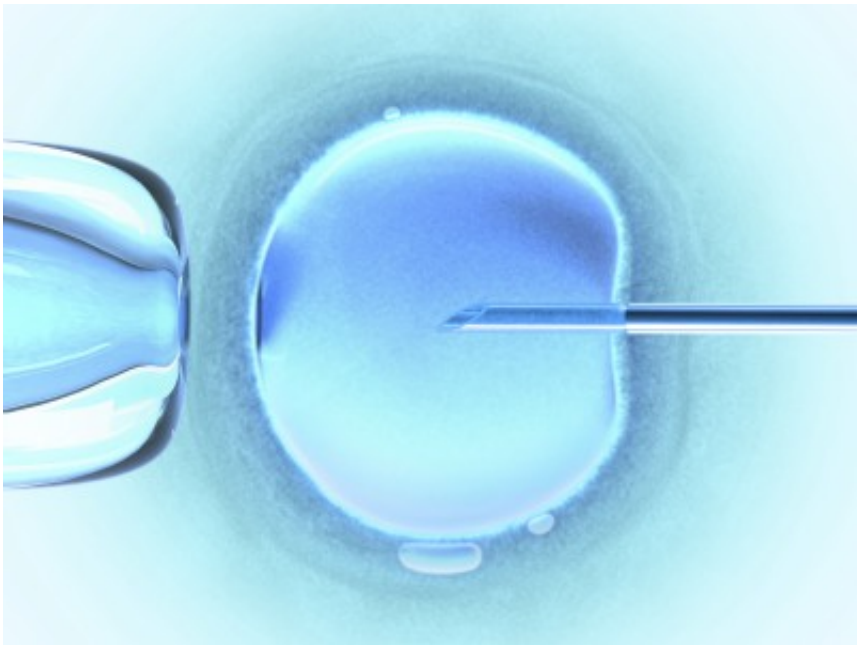

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(Phys.org) —In research published today in *Nature Cell Biology*, scientists from the EMBL Australia research team based at Monash University's Australian Regenerative Medicine Institute (ARMI) have revealed new insights into how cells organise and form an early mammalian embryo.

In an early mammalian embryo, just 8-cells large, the roundish cells do something they had never done before – something that would determine whether the embryo survived or failed. They change their shape. The

cells become elongated and compacted against each other, before returning to their rounded shape and dividing again and again.

When compaction does not occur, embryos tend not to survive. And the timing of compaction has been linked to success in IVF (in vitro fertilisation) treatments. But how did these young, seemingly featureless cells undertake this vital shaping process?

Researchers Dr Nicolas Plachta, Dr Juan Carlos Fierro-González and Dr Melanie White have found a new mechanism controlling the process. The team used live imaging technology and microinjected fluorescent markers to capture the action in vivid images and video.

"Our images reveal arm-like structures called filopodia appearing on the outer membrane of some cells during the 8-cell stage, and it is these filopodia that are responsible for contorting cell shape, and forming the embryo's first tissue-like layers," Dr Fierro-González said.

"For the first time, we have been able to watch as filopodia reach out and grab neighbouring cells, pulling them closer and elongating the cell membranes. We think that this enables the cells to effectively compact, as their new non-rounded shape makes the most of the available space."

But the role of filopodia was made clearer upon seeing what happened next.

"We then saw the filopodia retract as they released their grip on neighbouring cells, allowing them to return to a somewhat rounded shape before they continued on their journey of cell division," Dr Fierro-González said.

Dr Plachta and his team observed that cell division never occurred while filopodia were extended over the cells, but only once the filopodia had

retracted. These observations have lead the researchers to believe that the filopodia provide the necessary surface tension to allow the cells to undergo expansion and compaction.

"Our findings reveal a completely unanticipated mechanism regulating the earliest stages of embryo development, and we can apply that knowledge to human IVF treatments," Dr Plachta, Leader of the Plachta Group, said.

Dr Plachta and his team are pioneering live imaging techniques to watch mouse embryos developing in real-time. And they are already working in partnership with the Monash School of Engineering to improve implantation success rates for human embryos.

"Now that we know what controls early development, we are designing non-invasive imaging approaches to see if human embryos used in IVF form normal filopodia and undergo normal compaction. This could help us choose which embryos should or shouldn't be implanted back in the uterus," Dr Plachta said.

More information: Cadherin-dependent filopodia control preimplantation embryo compaction, DOI: 10.1038/ncb2875

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