

# How the gut gets its villi

October 14 2013

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Villi are small epithelial protrusions that serve to increase the surface area of the gut for efficient nutrient absorption. The mechanism of their formation during development was recently revealed by a study published in *Science*. The investigations, carried out by two research groups at Harvard University, were complemented by computational modelling carried out at the University of Jyväskylä and funded by the Academy of Finland.

Villification (villus formation) has previously been hypothesised to be based on an active mechanism coordinated by growth factors. The present study, however, shows that a simple mechanical compression of the [epithelium](#) sheet is all that it takes. The epithelium gets compressed mechanically as the surrounding layers of smooth muscle differentiate and grow slower than the epithelium. This compression leads to a spontaneous buckling of the epithelium first into longitudinal folds, then a zigzag pattern, and finally villi. The non-uniform distribution of [growth factors](#) and cell differentiation turned out to be a consequence – not a reason – of the complex epithelial topography.

Physicists and mathematicians had studied the mechanical surface instabilities essential to villification a few years earlier, but the theoretical results have not been applied before to explain the morphogenesis of [biological structures](#) at quantitative level. In a broader view, the study reminds us that even complex biological structures form just as a sequence of simple physical processes.

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Tuomas Tallinen were the lead authors of the study, carried out under Professors C. J. Tabin and L. Mahadevan. The computations were run at CSC – IT Center for Science in Finland.

**More information:** E. Shyer, T. Tallinen, N. L. Nerurkar, Z. Wei, E. S. Gil, D. L. Kaplan, C. J. Tabin, and L. Mahadevan, "Villification: How the Gut Gets Its Villi", *Science* 342, pp. 212–218 (2013), [www.sciencemag.org/content/342/6155/212](http://www.sciencemag.org/content/342/6155/212)

Provided by Academy of Finland

Citation: How the gut gets its villi (2013, October 14) retrieved 27 April 2024 from <https://medicalxpress.com/news/2013-10-gut-villi.html>

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