Pediatric and Developmental Pathology – The distal villous hypoplasia (DVH) pattern is connected to fetal growth restriction of the placenta, potentially offering a new approach to placental evaluation. As corresponding author David Grynspan explains, “Growth restriction of a fetus in pregnancy has health implications for the fetus that could be lifelong—and for the mother in subsequent pregnancies. Aside from its clinical significance, our study helps shed light on the deeper mathematical aesthetic behind humanity’s unique mother–child interface.”

In the article “The Placental Distal Villous Hypoplasia Pattern: Interobserver Agreement and Automated Fractal Dimension as an Objective Metric,” the writers propose that, because the DVH pattern seems to be simpler than comparably developed placental villi, DVH could also correlate to lower fractal dimension. The study aimed to assess interobserver agreement connected to the DVH pattern among skilled pathologists and to conclude whether that pathologist classification of DVH also correlated with fractal dimension.

Grynspan notes that “placental exam until now has not been as helpful as we hoped, in part because it involves looking at two dimensional cross sections of a tree-like structure. In our study—by using the mathematics of fractals—we are able to find an objective quantitative measure that tells us how complex a placenta’s branching pattern is. Just as trees growing in low light condition are sparser—sacrificing lushness for function—so too is the placenta in restricted conditions.”

To conduct the study, one expert pathologist created a set of 30 digital images of placental parenchyma at 4x magnification. The images were graded for the DVH pattern at no, mild to moderate, and severe levels of DVH. Four additional international pathologists were shown the images in a randomly sorted array and graded them similarly for DVH. Using the data, weighted kappas were calculated, and fractal dimension in each image was calculated using the box counting method.

Ultimately, the study’s findings imply that fractal dimension could offer a new approach to objective and quantitative evaluation of the DVH pattern in placental tissue. Grynspan explains that “the research is important because, for a long time, we have believed that the placenta should allow us to differentiate fetuses that are growth-restricted from those that are just smaller as part of the normal spectrum.” While further studies are needed, this one suggests that fractal dimension could offer solid proof of villous abnormalities in placental pathology.

The writers recommend that future research attempt to connect fractal dimension of DVH with measurable outcomes that affect mother and child.

https://www.youtube.com/watch?v=DFPtNTLQWBo