The Fractal Structure of Caries?

G.		Landini
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Dear Sir,

In a recent issue of Caries Research, Gonzalez-Gonzalez [1] proposes that the unpredictability of the relative frequencies of caries per tooth in 479 individuals is a proof that caries has a 'fractal structure'. That statement is misleading at least in two aspects. First, fractal objects are characterised by self-similarity over large ranges of scale (usually various orders of magnitude) while in the case presented by Gonzalez-Gonzalez the 'scale' is an artificial one which is simulated by considering different ranges of ages when plotting the relative frequencies of caries in the sample for the different teeth. It could be argued that there is no characteristic profile of the relative caries since the plots seem to be different (although no statistical proof was presented), but per se, it does not suggest fractal scaling. Unpredictability (either due to chaotic dynamics or to randomness) does not necessarily imply the presence of fractal structure. Secondly, there is no proof of any fractal attributes other than the 'look' of three graph profiles considered. A fractal structure should reveal some kind of 'fractal dimension' in terms of a scale invariant geometrical attribute that reflects the degree of geometrical complexity [2]. This is usually derived from a power law of the type $y=ax^b$ through linearisation of a multiresolution geometrical measurement by a log-log transformation, but this was not attempted by the author and therefore the claim of a fractal structure of caries remains unproved. Moreover, the type of data investigated does not span even one order of magnitude (actually it is 1:2 as stated in fig. 3) to justify any fractal behaviour. The study also failed to consider the cumulative effect of caries, and that of extracted teeth on the final shape of the frequency profiles. Simple statistical analyses (such as χ^2 , or distribution-independent tests like the Kolmogorov-Smirnov test) may be able to demonstrate whether the relative distribution of caries per location at different ages is, in statistical terms, the same or not. Fractal geometry is not related to this problem.

Caries Res 1997;31:401

Reply

Fractal Structure of Caries: Yes!

Dr. Jesus M. Gonzalez-Gonzalez

First, at a particular moment of time, the statistical survey of caries of a population is always predictable – however, when the time passes many of these carious lesions may or may not be treated, some teeth may be lost etc. and it is likely to become unpredictable in the long term. We prefer not to use statistics; we prefer to study the problem from a different approach through graphic images that allow us to see better the variations in each group studied. In order to know what happens during 50 years, we chose a 16- to 65-year-old population that is graphically presented with a scale 1:1. Any other smaller group taken from that group should be presented with a bigger scale to be comparable. The scales are neither artificial nor simulated, they

correspond to the data graphic presentation according to a point of view different from a purely statistical one. Obviously the autosimilarity of the images would be able to be better seen if the studied population groups were larger and more scales were used.

Second, the fractal term defines, in a general way, irregular objects. Some of its characteristics are, among others, autosimilarity, its fractal dimension or a mathematical algorithm that identifies it. The last two characteristics are not presented in my work because it is considered to be only an approximation to the problem. Obviously, both data are very important to determine any fractal geometry and they have to be considered in future works.

References

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