Cardiac structure/function relationships: Reality or deduction?

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Experimental results, rather than deductions, become the final arbiter of scientific questions. To be useful, any anatomic description of the heart must address the well-documented *in vivo* movements structure that explains observed function because anatomic observations alone are of little value if they ignore the normal heart's coordinated and repetitive sequential motion.

Achievement of this objective requires building on prior contributions, and Anderson and colleagues have helped enormously in supplementing the landmark contributions of prior anatomists by (1) confirming the recognized clockwise and counterclockwise muscle formation with a transverse band at the base of the heart²; (2) demonstrating the collagen network housing that surrounds reciprocal helical fibers in Lunkenheimer's studies,³ which endorse the collagen weave network suggested by Grant⁴ in 1965; (3) corroborating Grant's observation suggesting the networking of fibers with angulated connections of myocytes to each other,⁴ a finding that provides structure to explain the sequential twisting motion; and (5) identifying a 100-ms prolongation of contraction in the outer oblique fibers,⁵ which supports the sequential contraction of the ascending segment of the apical loop defined by Torrent-Guasp⁶ but simultaneously disputes their synchronous contraction concept.⁵ Their statement that the heart is made up of millions of individual myocytes set in axially coupled endless chains in a preferential direction conveying a "grain" pattern might be correct but offers a potentially impossible solution to solving the structure/function relationship. These isolated individual observations are pieces of a puzzle that Torrent-Guasp has unraveled, as shown in our accompanying manuscript.¹

The limitations of Anderson's current and prior⁷ functional analysis is evident by watching the working heart, the interconnected cardiac muscle fibers of which contract sequentially rather than synchronously, a distinction that is easily made by comparing regular movement with the apex and base twisting in different directions during sinus rhythm with the uniform global contraction that exists during atrioventricular pacing.

Anderson's repeated request to define an anatomic plane for different pathways⁸ is now evident¹ from the living moving septum studies that introduce functional evidence of a reciprocal fiber structure that contracts on either side of the desired plane in a helical configuration. Therein lies the experimental evidence of the structure/function correlation. Furthermore, fixed tissue studies can introduce artifacts that are absent in the functioning heart.

Anderson and his colleagues' lifetime experience must be judged by the ultimate goal of explaining the function of the living, pumping heart, a goal that the Torrent-Guasp helical myocardial band clearly accomplishes. Scientific balance is certified by reproducible data, and the 500-year delay of recognition of Galileo should not be forgotten because he had an answer and not a deduction. The simplicity of the discovery of Torrent-Guasp revolutionized my understanding of the structure/function relationships, and I believe that his contributions will equal or exceed those of William Harvey in fostering a dramatic expansion of our knowledge of the circulation.

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Received for publication Oct 15, 2007; accepted for publication Oct 21, 2007.

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J Thorac Cardiovasc Surg 2008;136:19-20
0022-5223/\$34.00

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doi:10.1016/j.jtcvs.2007.10.086

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