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Crisóstomo Martínez, 1638–1694

The Discoverer of Trabecular Bone

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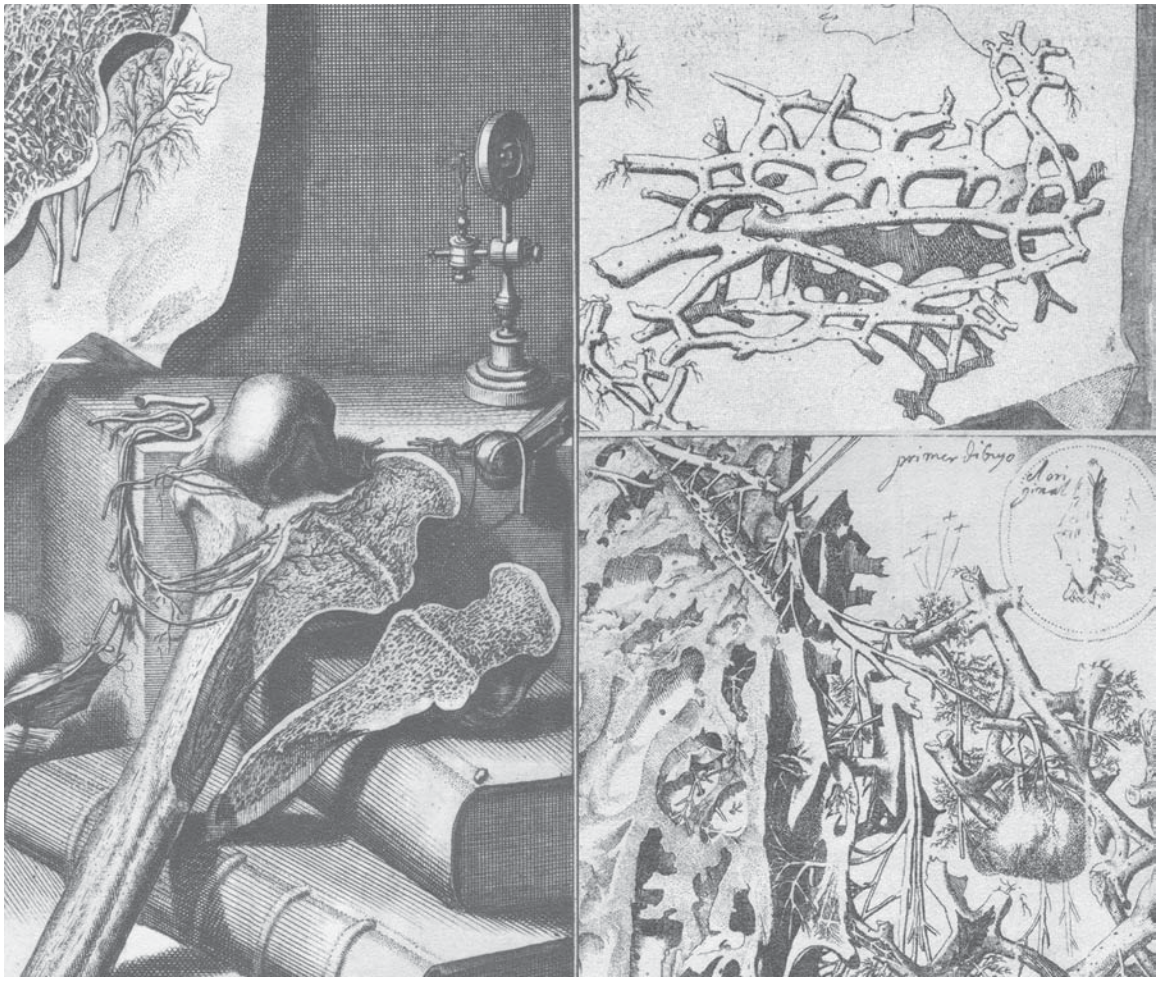

Fig. 1. (**A**) On the left. A simple microscope, the amplifying instrument used by Crisóstomo Martínez in his research on bone structure is showed. It consisted in a single optical lens, double-convex, with a short focal length. By modifying curvature of the lens, higher magnification (to reach several hundreds) was attained. Detail of Lamina V, from *(3)*. (**B**) On the top-right. 3-D trabecular structure drawn by Crisóstomo Martínez from an isolated minute portion of bone. Note that visualized images by simple microscope resemble closely that obtained nowadays by scanning electron microscope. Detail of Lamina X, from *(3)*. (**C**) On the bottom-right. Drawing of nerves and blood vessels in the bone marrow carefully dissected and observed using simple microscope by Crisóstomo Martínez. A dissecting hook separates a nerve and its small branches. Crosses (++++) point out branching arteries as observed by "nude eye." Next to it is shown at very high magnification the end part of one of these arteries, the branching pathway is finishing to form sinusoids, named adipose vessels and described by him as "small bags, small bladders of fineness walls beyond any measurement." Detail of Lamina XI, from *(3)*.

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In Paris, 1689, Crisóstomo Martínez, a Spanish anatomist and artist, studied the structure and functions of bone and bone marrow for two years. His time in Paris was not a chance event. Nine years earlier, notables of his home town in

Valencia had entrusted him with the task of preparing an Atlas of Osteology. Subsidized by the King of Spain, Crisóstomo Martínez had culminated this scientific labor in Paris as he could work with the "Academie of Sciences," a recognized center of excellence in Baroque Anatomy, to access the latest technological advances in engraving. By methodically dissecting a variety of dry and fresh bones, he made his careful and detailed observations using a novel amplifying instrument. He systematically applied different kinds of optical lenses to understand the fine structure of bone. At first, low magnification was used to study the gross structure, and then a series of lenses at increasing magnification was used to tease out the finer structures he had identified within his low-power field. With this simple microscope and an optical resolution of 0.7 μm *(1)*, he was able to observe the trabecular bone structure and its details (Fig. 1A,B). With extraordinary care and dissecting skills, he traced the pathways of branching arteries, sinusoids (which he named "adipose vessels"), and the emerging veins (Fig. 1C).

An experienced anatomist and microscopist, Crisóstomo Martínez described for the first time, the bone trabecular structure as a framework of delicate, intricate processes organized to support the bone marrow and to provide strength to the epiphyses and metaphyses. To illustrate these features, he worked as a painter and engraver to engrave four beautiful and accurate laminas of the gross structure of bone, trabecular bone, and the bone marrow vessels. Just a few years later in 1691, Clopton Havers was to be credited with the first descriptions of cortical bone structure, while Leeuwenhoeck contributed the first brief descriptions of Haversian canals within the same period *(2)*. Neither man portrayed bone structure with the attention to the finer details, intricacies, and complexity of trabecular bone so meticulously rendered by Crisóstomo Martínez in his etchings.

Crisóstomo Martínez died in 1694, leaving nineteen engraved plates. His Atlas of Osteology was never published. Two of his engraved plates (Lamina XVII and XVIII) were printed during his lifetime; the first in Paris in 1690, and the second in Frankfurt-Leipzig in 1692. The Academie Royale de Peinture reprinted the lamina plates twice between 1740 and 1780. Crisóstomo's works impressed and excited his colleagues and acquaintances. The engravings were frequently used and cited (for example, by Haller A: *Bibliotheca Anatomica Tiguri* 1774–1777).

The original engravings are preserved at Historical Archive of the City of Valencia. In 1964, the historian, López Piñero *(3)* carefully edited a facsimile with a complete collection, once again astonishing the scientific community with the beauty and accuracy of these early illustrations of trabecular bone.

References

1. Ford, B. (1993). *El nacimiento de la Microscopía.* Mundo Científico, **13(132):** pp. 116–124.
2. Martin, R. and Burr, D. (1989). In: *Structure, function and adaptation of cortical bone.* Chapter 1. The historical development of concepts surrounding the structure and function of bone. New York: Raven Press, pp. 1–7.
3. López Piñero, J. M. (1964). *Atlas Anatómico de Crisóstomo Martínez. Grabador y Microscopista del siglo XVII. Estudio y transcripción de Jose María López Piñero.* Ayuntamiento de Valencia. Valencia, Soler A, Jávea.