Leonardo Da Vinci: The Pioneer of Scientific Drawings

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Abstract. The objective of this research is to understands the link between art and anatomy during the Renaissance. The Renaissance period marked a renewed interest in the artistic principles and techniques of classical antiquity in the fifteenth century, leading to a “rebirth” of classical styles and innovations in art, as well as new interpretations made between art and science. The influence of art on the medical field is indispensable. This essay explores how scientific drawings have been developed over time by Leonardo da Vinci. During the sixteenth century, Leonardo da Vinci, a pioneering artist, examined and dissected the human body. Leonardo da Vinci’s discoveries have made a huge impact on the development of physiology, as new knowledge of the human body was discovered through his observational drawings. His sketches have not only depicted images, but detailed writings beside them as well, demonstrating his medical knowledge. Influenced by Leonardo’s use of tonal modeling in his sketches, medical images started to be depicted more realistically, by creating three dimensions. This was never shown in the anatomical drawings before.

Keywords: The Renaissance, Leonardo da Vinci, anatomical studies, human body, dissection.

1. Introduction

Dissecting the human body was a hard thing to achieve during the Renaissance, as people believed that God was punishing them in the Medieval period. It was believed that dissecting the human body was against the law and disrespectful to the sins, but Leonardo did it and was the first artist to dissect an entire human body. Understanding the human anatomy is very important for artists during the Renaissance. Figures are no longer elongated, weightless, or set still. Artists began to pursue naturalism after Giotto’s innovations during the Proto-Renaissance of the Middle Ages, which incorporated a sense of realism, and individualism, both requiring knowledge and understanding of the human anatomy. The status of artists changed from craftsmen to artists as an increase of education was brought by the Humanists, more artists began to turn to science to improve the depiction of human figures in their artwork [1]. Artists began to grow more interested in discovering what is underneath the skin, and the forms of musculature when doing movements, which led the sixteenth century to be known as "the century of anatomy" [2]. At the time, public dissections of executed criminals even became a popular event in Italy, where anatomical dissections were conducted with greater freedom than anywhere else.

2. Leonardo’s Anatomical Drawings

Leonardo’s anatomical drawings are both scientific and artistic, with impressive skillful drawings that may help artists develop better understandings of musculature in human figures, as well as discoveries of inner features carefully recorded for the medical field. From 1510 to 1511, Leonardo worked alongside anatomy professor Marcantonio Della Torre at the University of Pavia's medical school, where he may have dissected as many as twenty human bodies in this period [3]. Leonardo kept a record of his discoveries on eighteen sheets of paper, which are now referred to as Anatomical Manuscript A. As he dissected more bodies, Leonardo's research began to focus on bones and muscles rather than just concentrating on the internal organs. According to Leonardo’s notebook, it states: “...the nerve branches with their muscles serve the nerve chords as soldiers serve the officers, and the nerve chords serve the sensus communis as their officers serve their captain, and the sensus communis serves the soul as the captain serves his lord” [4]. This enhances Leonardo’s understanding of the musculature system by describing the body as a hierarchical system. This also shows how much

research Leonardo conducted in order to gain such a thorough understanding of how the various systems of the human body work.

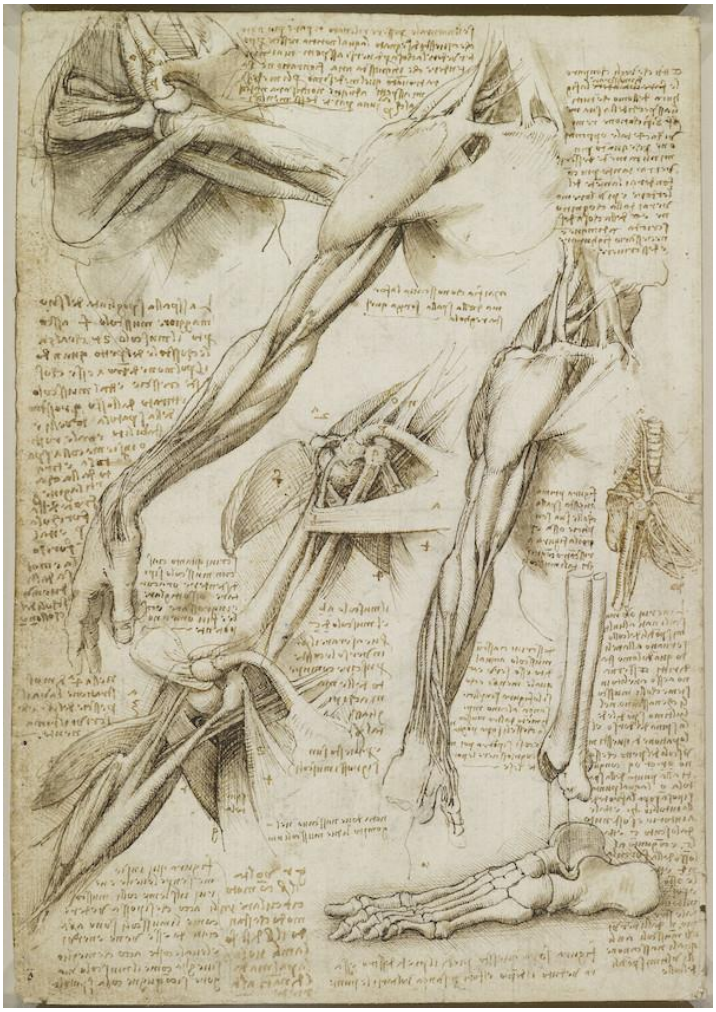

Figure 1. Leonardo Da Vinci, The muscles of the shoulder and arm, and the bones of the foot, c.1510–11, Pen and ink with wash over black chalk, 28.9 × 20,1 cm, Royal Collection Trust [5]

Leonardo has done a lot of anatomical studies, and one of the densest anatomical sheets is *The muscles of the shoulder and arm, and the bones of the foot* (Fig.1) drawing made with pen and ink with wash over black chalk in around 1510 to 1511. The anatomy of the arm and shoulder are the main subjects in this complex anatomical study by Leonardo. The largest drawing on the top center and the drawing on the center-right of the page depict a slightly different view of the same stage of dissection, whereas the drawing in the middle of the page displays a larger portion of the shoulder joint. The use of pen and ink allows Leonardo to create details of tendons and muscles, for the image to be drawn with more anatomical accuracy. Washing parts over with black chalk on the other hand adds tonal values to the different parts in shadow, creating depth and three-dimensionality. The monochromatic color scheme also makes the study look more factual and believable for further studies. Leonardo did not label the anatomical components in his drawing; instead, he included annotations on the side that described how the chest cavity expanded by following a series of muscular actions, although none of these structures has a major impact on the Chest's expansion. This suggests that Leonardo has not only the knowledge of anatomy but also of how the structure of the body functions as a whole. Martin Clayton, the head of prints and drawings in the Royal Collection describes Leonardo as the epitome of an artist who was both a highly proficient dissector or an anatomist who could also draw. What set Leonardo apart was the combination of these two abilities in a single figure [6]. This again indicates that Leonardo made great contributions to both the art and the medical world. As a sculptor, engineer, and one of the greatest artists in the Renaissance period,

Leonardo da Vinci produced numerous significant discoveries. He produced the first accurate illustration of the human spine, and his notes from the dissection of the Florentine centenarian contain the earliest known description of liver cirrhosis [6]. Throughout his life, he dissected over thirty bodies of both sexes. Leonardo's interests extended beyond the mechanics of the body to include the origins and expression of emotions and helped develop more accurate images for physicians.

3. Leonardo Da Vinci's Errors

However, there are also some anatomical errors in his drawings, as there were a lack of source and technology at the time. For instance, in the anatomical study of the cardiovascular system and the internal organs of a female figure (Fig. 2), Leonardo drew around 1509 to 1510, in the following year of his first whole-body dissection of an old man. He imagined the ureter as a straightforward conduit through which fluids flowed according to gravity, and he even utilized a series of images to explain how changing body positions affected the flow of urine from the kidneys to the bladder [7]. This suggests a lack of understanding of the placement internal organs, which also shows that he drew from his imagination for some of the body parts. Moreover, the female reproductive system was not drawn directly from observation but was drawn more likely from what could be found in a female cow [7]. This emphasizes the limited access to female bodies during the Renaissance.

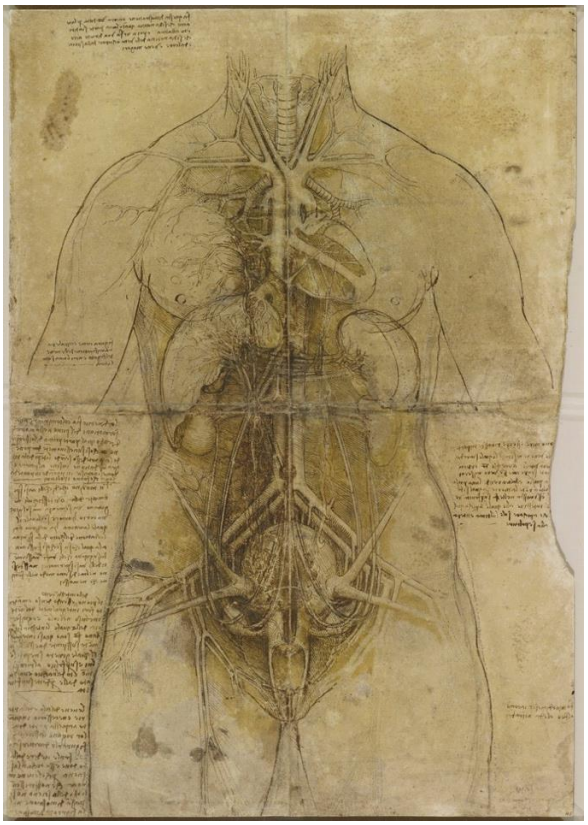

Figure 2. Leonardo da Vinci, The cardiovascular system and principal organs of a woman, c.1509-1510 [8]

Leonardo made important contributions even though some of his representations of human anatomy were incorrect. by producing remarkable predictions that was not yet discovered with the technology back then. For example, in the anatomical drawing of a bear's foot (Fig.3) Leonardo made between c.1488 and to1490 with a pen, metal point, and ink, white heightening, on blue-grey paper, he has successfully predicted how an anatomical structure of a human foot would look like, where he discovered the identical structure in human hands and feet two decades later. At the beginning of Leonardo's discovery in anatomy, he did not have access to human dissections. Therefore, Leonardo dissected animals instead.

Figure 3. Leonardo da Vinci, The Anatomy of a Bear's Foot, c.1488-1490, Metalpoint, pen and ink, white heightening, on blue-grey prepared paper, 16.1 x 13.7 cm [9]

4. Comparison with Contemporaries

Similarly, artists like Michelangelo were also interested in human anatomy at the time, especially around the musculature system. However, unlike Leonardo, Michelangelo aimed to understand the surface of the body as he dissected the underlying skin and muscles. He dissected bodies to understand how muscles worked to make his artworks more naturalistic, not to make discoveries in the science world. Michelangelo's drawings focused mainly on capturing the power and energy of the human form, and he mastered the technique of chiaroscuro in his sketches to emphasize musculature (Fig. 4), no matter whether male or female. It can also be noticed that there are no captions on the drawing and is mostly drawn in preparation for the later painting (Fig. 5). Even though the figure in the painting is female, Michelangelo still drew it as a male body because it was hard to find a female body to draw at the time.

Figure 4. Michelangelo, Studies for the Libyan Sibyl (recto), c. 1510–11, red chalk, 28.9 × 21.4 cm, The Metropolitan Museum of Art [10]

Figure 5. Michelangelo, Libyan Sibyl, c. 1511, fresco, part of the Sistine Chapel ceiling (Vatican Museums) [11]

5. Conclusion

To summarize, Leonardo da Vinci made a huge contribution to anatomical studies in his career. He utilizes a broad knowledge of anatomy through his drawings and descriptive notes, demonstrating that he is not only a skillful artist, but a talented anatomist as well, representing the finest anatomical drawings ever made. Artists' profound anatomical curiosity is the key to discovery, without Leonardo's discovery in Anatomy, the understanding of human anatomy would be lagged behind. Through creating scientific drawings, artists could depict human bodies in perfection, and physicians could also understand the function of human body in a more advanced way.

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[9] Leonardo da Vinci, The Anatomy of a Bear's Foot, Metalpoint, pen and ink, white heightening, on blue-grey prepared paper, c.1488-1490.

[10] Michelangelo Buonarroti, Studies for the Libyan Sibyl (recto), red chalk, with small accents of white chalk on the left shoulder of the figure in the main study, 28.9 × 21.4 cm, The Metropolitan Museum of Art, c. 1510–11.

[11] Michelangelo, Libyan Sibyl, fresco, part of the Sistine Chapel ceiling, Vatican Museums, c. 1511.