

The Superficial Venous System: Art and Anatomy in Michelangelo's Works

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1. Abstract

The Renaissance period was a laboratory of extensive scientific and artistic production that also included the study of the human body for both medical and artistic purpose. The artists of this period, especially those of the Italian schools, were particularly fascinated by human dissection and began to attend or perform public human dissections or public lessons of anatomy. They paid particular attention on superficial anatomy, especially on muscles, to understand body dynamics, but only a few of them focused on other neglected subcutaneous structures (veins, nerves, lymph nodes). Michelangelo Buonarroti (1475-1564), one of the most brilliant artists in Italian High Renaissance, had a wide knowledge in human anatomy coming from his experience in public dissection, when he joined to the court of Lorenzo de' Medici, and later in life thanks to the friendship with the anatomist Realdo Colombo. The present article aimed to examine Michelangelo's works, following a chronological order, to find the presence of subcutaneous veins. When represented, the anatomical correctness of the superficial venous network has been evaluated in marble sculptures and frescoes of the Sistine Chapel. Interesting anatomical considerations arose from the analysis of his famous works, in particular *Pietà* and *David*. Michelangelo paid a particular attention to anatomical dissection, this research being finalized to achieve detailed information for artistic purposes. The representation of distended superficial veins also contributed to transmit additional physical effort and emotional states in his masterpieces.

2. Introduction

The artistic production of the Middle Ages mainly emphasized the spiritual message to the detriment of the human body, whose representation was anatomically imperfect accordingly. On the contrary, the artists of the subsequent period considered the man at the center of their attention and the classic masterpieces of ancient times were rediscovered. Renaissance was a laboratory of extensive scientific and artistic production and the mannerism just indicated the stylistic approach dealing with the ideals of artists such as Leonardo da Vinci (1452-1519), Raffaello Sanzio, known as Raphael (1483-1520), and early Michelangelo Buonarroti (1475-1564). Although unpleasant and formally not recommended, the anatomical dissection was the best tool to investigate the structure of the human body. The anatomical revolution occurred with the "father of modern anatomy", Andreas Vesalius (1514-1564) and the publication in 1543 of his fundamental masterpiece *De Humani corporis fabrica* [1].

The artists were particularly fascinated by human dissections. Painters and sculptors of this period, especially those of the Italian schools, not satisfied with copying the nudes of antique masterpieces, began to study the human anatomy, to better reproduce the details of the human body in their works. In this respect, the Florentine Academy of Art instituted an obligatory course dedicated to anatomy. Students realized drawings having cadavers and skeletons as models. The artists were mainly interested in the investigation of the superficial anatomy, limited to the study of flayed (*écorché* or *spellato*/ *scorticato*)

cadavers to understand the muscular arrangement, and only a few of them paid attention to other neglected subcutaneous structures (veins, nerves, lymph nodes). The artistic version of this iconography was the so-called *Lo Scorticato* (flayed man), a red wax little statue realized by Lodovico Cardi (1559-1613), known as Cigoli, with superficial muscles exposed, and now in the Museo Nazionale del Bargello (Florence). Similarly, the best known work by Marco d'Agrate (c. 1504 - c. 1574) is the impressive statue of *Saint Bartholomew Flayed* (1562), realized to decorate the southern side of the Cathedral of Milan and now exposed in its transept. Unlike Cigoli's work, the superficial muscles of this statue is covered by a complete network of tortuous subcutaneous veins.

Michelangelo was an Italian sculptor, painter, architect, poet and engineer, considered one of the most famous and brilliant artists in Italian High Renaissance [2-5]. Thanks to the friendship with the anatomist Realdo Colombo, he was also interested in dissecting human corpses, as other artists of his time. His deep knowledge in human anatomy turned into marvelous masterpieces, including sculptures, paintings and drawings [6,7]. Apart from this well-known Michelangelo's expertise in anatomical studies, in some works different anatomical structures have been curiously envisaged in the ceiling of the Sistine Chapel, as encoded hidden messages [8-14]. This pareidolia has been partly criticized just in terms of visual illusions [15-18].

This study aims to investigate the presence of the superficial venous system in the masterpieces realized by Michelangelo. The superficial veins are located in the subcutaneous tissue and are accompanied by other superficial structures, including sensitive nerves, lymphatic vessels and lymph nodes. They are usually provided with valves and communicate with the deep venous system by perforating veins. In spite of this evident position, subcutaneous veins are usually ignored by artists in their works. When represented, the anatomical correctness of the superficial venous network is evaluated in Michelangelo's sculptures and paintings.

3. Michelangelo and the Anatomical Studies

The interest of Michelangelo for the anatomical dissection is well documented by biographic, literary and iconographical sources. In the *Lives of the most eminent painters, sculptors and architects* Vasari (1912-1915, vol. IX, p. 11) [19] left important evidences of this interest:

For the Church of S. Spirito in the city of Florence Michelagnolo made a Crucifix of wood, which was placed, as it still is, above the lunette of the high-altar; doing this to please the Prior, who placed rooms at his disposal, in which he was constantly flaying dead bodies, in order to study the secrets of anatomy, thus beginning to give perfection to the great knowledge of design that he afterwards acquired.

Michelangelo's pupil, Ascanio Condivi (1525-1574), also published in 1553 an interesting biography, where the interest for anatomical studies of the famous artist was further assessed (Condivi, 1903, pp. 81-82) [20]:

And because Michael Angelo has now reached a ripe old age, he thinks of putting his ideas in writing and giving them to the world. With great devotion he has explained everything minutely to me; he also conferred with Messer Realdo Colombo, an anatomist and most excellent surgeon, a great friend of Michael Angelo's and mine. He sent to Michael Angelo for study the body of a Moor, a very fine young man, and very suitable to the purpose; he was sent to Santa Agata, where I then lived and still live, as it is a quiet place. On this corpse Michael Angelo showed me many rare and recondite facts, perhaps never before understood, all of which I noted down, and hope one day, with the help of some learned man, to publish for the advantage and use of painters and sculptors; but enough of this.

Since Michelangelo wrote poems as well, he submitted his verses to one of his friends, the playwright Donato Giannotti (1492-1573), for a revision. Giannotti underlined the importance of the anatomical dissection for artists in *Dialogi de' giorni che Dante consumò nel cercare l'Inferno e 'l Purgatorio* (1546), where Michelangelo is one of the characters. This is the praise of the interlocutor Antonio Petreo:

Therefore, it seems to me necessary that painters to have been able to imitate the movements of living bodies, that is animals, and especially men, must have made many anatomical dissections. They must have considered not only all the external parts of the human body, but also those that are inside, and not seen, such as the muscles, veins, nerves and bones. Without knowing the position and movements of these organs, painters and sculptors could not show us those figures that move as alive bodies. Whoever observes your statues that you made in Florence, and the figures painted in the vault of the Sistine Chapel, sees the figures as if they were alive. Who wouldn't be convinced of your anatomical knowledge? This knowledge belongs to the doctor.

In addition to these reports, it is also well known that, when moved from Pisa to Rome, the famous anatomist Realdo Colombo became acquainted with Michelangelo. Thanks to this friendship, Michelangelo was also informed about the important anatomical revolution by Vesalius, as well as other anatomists, including Andrea Cesalpino. Michelangelo should have illustrated Colombo's anatomical book, but this project was non accomplished. Maybe, like Leonardo da Vinci, he planned to write a personal anatomical book. Anyway, in the engraving by Paolo Veronese of the title page of *De Re Anatomica* – the only picture of the book! –, published in 1559, the year of Colombo's death, Michelangelo seems to be allegorically portrayed around the dissection table. Finally, although Michelangelo did not get along with Leonardo, we cannot exclude a reciprocal influence in the competition about anatomical studies between two such lofty minds.

4. Superficial Veins in Michelangelo's Masterpieces

Michelangelo's works were examined in chronological order, trying to identify the representation of the superficial venous network. In many Michelangelo's works subcutaneous blood vessels were not represented, with a doll-like skin appearing flat and smooth. For example, superficial veins are not evident in the two wood *Crucifix*

attributed to the artist in 1493, now in the Basilica di Santo Spirito (Florence) and in the Church of San Rocco (Massa). On the contrary, long before, in the work by Filippo Brunelleschi (1377-1446), this anatomical detail is remarkably evident in the upper limbs. According to Vasari, Brunelleschi criticized the *Crucifix* by Donatello (c. 1386-1466) as showing a *contadino* (farmer) on a cross. Challenged to realize a better work, Brunelleschi sculpted his own *Crucifix*, now in the Basilica of Santa Maria Novella (Florence). Donatello's first sight of that sculpture "perfectly finished" made him drop the eggs he was carrying (Vasari, 1912-1915, vol. II, p. 241) [19]:

Donato, therefore, entering the house and going into the hall, saw the Crucifix of Filippo, placed in a good light; and stopping short to study it, he found it so perfectly finished, that, being overcome and full of amazement, like one distraught, he spread out his hands, which were holding up his apron; whereupon the eggs, the cheese, and all the other things fell to the ground, and everything was broken to pieces.

The unfinished appearance of his early works spurred Michelangelo to a deeper knowledge of the human body to improve both scientific surface anatomy and art anatomy, especially for muscles. Experienced art anatomists were interested also in the discovery of deep structures, which in some cases can influence the superficial anatomy. Accordingly, the Spanish anatomist Juan Valverde de Amusco (c. 1520 - c. 1587) advised artists to know deep anatomy as well, and just praised Michelangelo for this in *Historia de la composicion del cuerpo humano*, published in 1556 (book II, third plate):

It is important to know not only superficial muscles (if painters want to reproduce in a good manner the different positions of the human body), but also the deep ones with their insertions, as well as the skeleton, to better understand how long, short, thick or thin must be illustrated a muscle. The correctness of this assertion was confirmed in the present time by the Florentine Michelangelo Buonarroti and the Extremaduran Pedro de Rubiales, who applied themselves to both anatomy and painting, becoming the most famous and excellent painters ever seen so far.

Apart from anatomical dissections, well documented in Michelangelo's practice, artists were also inspired by the observation of classic masterpieces and live models. In 1506 a young Michelangelo was present to the fantastic discovery of *Laocoon and His Sons* (*Laocoon Group*). This sculpture, where some superficial veins of the upper limb are well represented, may have further inspired Michelangelo for his subsequent sculptures.

In ancient times the anatomical dissection was prohibited, mainly for religious reasons. In spite of this, several classic statues are anatomically perfect. This means that an accurate observation of living models was enough to obtain a faithful reproduction of the human body [21]. This level of perfection and realism also includes the well-defined superficial veins. For example, the famous *Discobolus* of Myron, in the roman marble Lancellotti's copy, exhibits an astonishing repro-

duction of superficial veins of the upper limbs, including the dorsal venous network of the hand. Parallel veins are represented in the right upward upper limb, and oblique veins in the forearm of the left downward upper limb.

Thanks to the observation of live models or ancient masterpieces and anatomical experiences, Michelangelo improved his artistic activity. He was mainly interested in muscles and in their activity and contraction. Indeed, his sketches and works focused on muscles. Their examination shows different morphologies for the same muscle, when contracted or at rest. The "normal" anatomy is also changed under dynamic conditions by the presence of fasciae or ligaments, which can give a peculiar shape to a topographical region, according to the muscular movements involved. Michelangelo was particularly able to catch such dynamic conditions, suggesting that his perfection is due to accurate observations of live models, rather than to anatomical dissections. The question whether or not he invented muscles or realized "abnormal" positions is still a debated matter [22].

In his drawings Michelangelo represented nothing externally to muscles, such as superficial veins, rather he illustrated, in some cases, bones beneath them. According to Ciardi (in Rabbi-Bernard, 2003) [22], in this unusual technique of superimposed layers in the same picture, probably inspired by Colombo's anatomy, Michelangelo drew transparent bodies, anticipating radiologic images, in an attempt to realize living machines in action.

Michelangelo was able to further refine his artistic ability, and many anatomical details, including superficial veins, can be observed since early works.

5. Sculptures

In the wonderful marble sculpture *Pietà* (1497-1499) (Figure 1), in Saint Peter's Basilica (Vatican City), the anatomical details of the two figures were rendered to perfection. Muscles, tendons, veins and the rest of the body were admirably sculpted. Vasari also appreciated the presence of such details (Vasari, 1912-1915, vol. IX, p. 14) [19]:

Among the lovely things to be seen in the work, to say nothing of the divinely beautiful draperies, is the body of Christ; nor let anyone think to see greater beauty of members or more mastery of art in any body, or a nude with more detail in the muscles, veins, and nerves over the framework of the bones, nor yet a corpse more similar than this to a real corpse.

The abandoned downwards right forearm of Jesus clearly shows a network of turgid superficial veins. Some veins are evident on the dorsum of both feet, as well, suggesting the blood filling the vessel of the lower part of the body, as in living bodies. Distended veins can be also found in another *Pietà*, later sculpted by Pietro Baratta (1659-1729). This vital particular seems to prefigure the future resurrection. Crosby [23] wondered: *blood fills the arm veins of the crucified Christ. (What, no valves?)*. Seemingly Michelangelo was unaware of the existence of venous valves. The first description of venous valves

was provided by Hieronymus Fabricius or Girolamo Fabrizi d'Acquapendente (1533-1619) in his work *De venarum ostiolis* (1603).

Between 1501 and 1504 Michelangelo sculpted four statues for the Piccolomini Altar complex, placed in the Cathedral of Santa Maria Assunta in Siena. In one of these, representing Saint Paul wrapped in a large and heavy drape, both downwards hands clearly evidence tendons of extensor muscles, as well as superficial turgid veins. The left forearm is flexed on the abdomen to hold a book, while the right upper limb is completely extended along the body. Then, only in the dorsum of the right hand the venous arch in the distal metacarpal region is also well evident.

In the same period, Michelangelo sculpted also the young hero David, one of the most famous marble statues of the world. He chose to represent the slinger before his single combat against Goliath. The challenging strength of the hero is expressed by the muscular tension shown in the contrapposto pose, being the body supported with the right leg, while the left leg carried forward. The right upper limb falls along the body: cephalic vein in the arm and median cubital vein in the elbow appear moderately turgid. In the dorsum of the right hand an irregular venous arch superimposed to the tendons of extensor muscles is remarkably delineated. On the ulnar side of this arch it is well evident the origin of the basilic vein, the largest superficial vein of the upper limb. An uncommon initial tract of this vein resembles a question mark (Figure 2). Then, its typical spiral course in the posterior side of the forearm is perfectly rendered. The left upper limb is flexed, with the hand to shoulder height. In this position veins are empty, because the blood is drained by gravity and Michelangelo correctly did not sculpt visible veins.

Surprisingly, Michelangelo did not represent turgid veins in the *David's* lower limbs, apart from a very short venous tract on the medial margin of the partially lifted left foot. Saphenous veins are not evident.



Figure 1: Michelangelo Buonarroti. *Pietà* (Juan M Romero - Opera propria, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=46153417>).



Figure 2: Michelangelo Buonarroti. *David*. Detail of the right hand showing a network of turgid superficial veins and the initial tract of the basilic vein (Jörg Bittner Unna, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0/>>, via Wikimedia Commons).

Interestingly, the right side of the *David's* neck shows a distension of the external jugular vein on the sterno-cleido-mastoid muscle until the clavicle (Figure 3). This superficial vein is not normally evident at rest, whereas it is particularly turgid during physical efforts, for example when singing, blowing or screaming. In a recent paper Gelfman [24] hypothesized this finding as a pathologic sign of elevated intracardiac pressure and possible heart dysfunction. However, he also interpreted this venous distension as the consequence of muscular tension before the combat. Indeed, *David* also appears markedly frowning with tense muscles. Anyway, since *David's* head is turned left, the taut skin flattens the right external jugular vein against the sterno-cleido-mastoid muscle. Then, this vein does not appear so turgid or tortuous.

Again, in another angry figure, the marble statue of *Moses* in San Pietro in Vincoli (Rome), commissioned in 1505 by Pope Julius II for his tomb and completed in 1545, Michelangelo rendered tense muscles and turgid superficial veins. In particular, swollen veins are evident on the dorsum of both hands, as well as a distended external jugular vein on the right side of the neck.

In the *Genius of Victory* (1532-1534), related to the project for the tomb of Pope Julius II and thereafter placed in the Sala Grande of Palazzo Vecchio in Florence, Michelangelo sculpted some superficial veins only in the right suprapubic region, probably because of the marked torsion of the torso of this allegory of victory.



Figure 3: Michelangelo Buonarroti. *David*. Detail of the neck with an evident external jugular vein (Jörg Bittner Unna, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0/>>, via Wikimedia Commons).

6. Frescoes of the Sistine Chapel

Michelangelo's frescoes of the Sistine Chapel in the Vatican City are considered one of the most famous masterpieces of the Italian Renaissance. They include the paintings of the ceiling of the chapel (1508-1512) and *The Last Judgment*, covering the whole altar wall of the same chapel (1535-1541).

Also in this admirable work Michelangelo showed his anatomical knowledge. Only some figures exhibit evident turgid superficial veins. In particular, a distended external jugular vein on the right side of the neck is appreciable in different figures. In *The Last Judgment* this vein is found in the central group around Christ, on the neck of John the Baptist (Figure 4), as well as on three figures (in one of them the vein is on left side of the neck) depicted on the right of the bottom part of the scene of *The Resurrection of the Dead*.

Again, this vein is well evident in some figures of the ceiling of the chapel. It appears very distended in the scene of *The Brazen serpent*, where the suffering figure is pressed by the coils of the snake (Fig. 5). In the scene of *Haman's punishment*, the dynamic posture of the figure reveals a turgid vein and this detail is also present in the preparatory cartoon. Finally, in the famous *The Creation of Adam* the first man

seems to show a slight line resembling the external jugular vein on the right side of the neck.



Figure 4: Michelangelo Buonarroti. *The Last Judgment*. The external jugular vein is evident on the neck of John the Baptist (Public domain, via Wikimedia Commons).



Figure 5: Michelangelo Buonarroti. Ceiling of the Sistine chapel. The external jugular vein is evident in the scene of *The Brazen serpent* (Public domain, via Wikimedia Commons).

Just inspired by Michelangelo's style, the Mannerist painter Agnolo Bronzino (1503-1572) is another example of anatomical attention to the superficial venous system. In the work *Venus, Cupid, Folly and Time*

(c. 1545) of this artist, the hand and the forearm of the right upper limb of Time, represented by an old man, exhibit a well delineated venous network. The same particular is evident in the satyr of *Venus, Cupido and Satyr* (c. 1553). The hands in the Portrait of *Ludovico Capponi junior* (c. 1551) also show distended veins.

7. Conclusions

The representation of the superficial venous system, especially in dynamic conditions, indicates that Michelangelo took care of this anatomical detail. Dependent veins are distended (venous pooling) when working in upright posture against gravity, which impedes blood return to the heart. However, presence of venous valves, communication with the deep venous system through perforating veins, adaptation mechanisms and muscular activity avoid pathological distension. Then, distension of veins of the upper limbs depends on their position with respect to the heart. In addition to this, venous pooling also depends on particular muscular activities, when blood drainage is temporarily impeded and veins engorge, this condition being typical in males. In this respect, the consideration of Michelangelo for the external jugular vein is noteworthy. Accordingly, the examination of female figures in Michelangelo's sculptures and paintings did not reveal anatomical details of the superficial venous circulation.

These anatomical particulars cannot be understood when dissecting a corpse, suggesting that Michelangelo also studied and drew from human live models to catch dynamic postures in order to realize more realistic and impressive works.

Usually, the blood circulating in the venous superficial network conveys into the deep one through valve-equipped perforating veins. Exceptionally, because of the contact of the foot with the ground, the superficial venous network of the dorsum receives tributaries from the deep veins and appear always distended. Surprisingly, the superficial venous circulation of the foot was almost neglected by Michelangelo. Maybe, the artist attached more importance to the venous circulation of the upper part of the body.

Unlike Michelangelo, Leonardo da Vinci performed more scientific anatomical drawings and he was particularly fascinated by the cardiovascular system. His sketches provided a very accurate and complete description of the superficial venous network of the human body. By the way, the posterior arch vein in the leg is named Leonardo's vein [25], since this vein appears in some Leonardo's plates (Vangensten et al., 1911-1916; v 5, f 3r and f 20v) [26]. This blood vessel was also named Michelangelo's vein in some books dealing with the venous network of the lower limb [27,28], but this particular vein was not found in Michelangelo's works.

It can be concluded that Michelangelo paid a special attention to anatomical dissection, in order to achieve detailed information for artistic purposes and to understand body dynamics. This approach allowed Michelangelo to realize very impressive masterpieces, where the muscular contraction was able to fix specific postures. The representation of distended superficial veins also strongly contributed

to transmit additional physical effort and emotional states. On the contrary, in many other masterpieces, characterized by hieratical or symbolic postures, Michelangelo did not realize particular surface contours to evidence specific dynamic expressions.

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