

Rembrandt's *Anatomy lessons*

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ABSTRACT

Introduction. Besides the joy they can bring us, the arts, and in this specific case painting, enable us to analyse and reflect upon historical information on the status and development of science. In his *Anatomy lessons*, Rembrandt's brush transmits far more than a superficial analysis may seem to reveal. These works speak of society, of science, even of transcendence.

Methods. The author performed a detailed analysis of two masterpieces by the Dutch Baroque master Rembrandt and the context in which they were created. The works in question are *The anatomy lesson of Dr Nicolaes Tulp* and *The anatomy lesson of Dr Deijmann*; the latter is possibly the most famous neuroanatomical image in art history.

Results. A detailed description is given of both of the works, their interpretation, and their inaccuracies; and of the historical, intellectual, and artistic context of the time when they were painted.

Discussion. We comment on the state of science in general and anatomy in particular in Protestant Europe in the 17th century.

KEYWORDS

Anatomy, Baroque, dissection, neuroanatomy, painting, Rembrandt

Introduction

In order to truly understand the subject, the work, and the author, it is essential to address the context surrounding them.

Historical context

Amsterdam was part of the Calvinist Dutch Republic, which won its independence from Spain in the Eighty Years' War (1568-1648), enabling it to engage freely in commerce.

It should be noted that the country also had fortune on its side: its main trade adversary, Venice, had been ravaged by the bubonic plague that struck northern and central Italy. The disease killed one-third of the adult

population of the Republic of Venice due to the decision not to introduce appropriate quarantine procedures in order not to hinder trade; this led to the decline of Venice as a maritime power.¹

In the 17th century, "the Dutch Golden Age," half of all European commercial transactions were made on Dutch ships, with the country's ports spanning halfway across the world, from the Indian Ocean (Formosa, Japan, Java, the East Indies) to the Atlantic (the Guianas, Brazil, and New Amsterdam).¹ The Dutch art of the 17th century was distinguished by the country's wealth and was driven not by the aristocracy but by the bourgeoisie and its demand for paintings.

The iconoclastic protestant ideology was flexible towards

the visual enjoyment of the powerful. Calvinism and the absence of a monarchy meant that artworks were commissioned not by royalty or the Catholic Church, but by guilds of craftsmen or such liberal professions as medicine; this resulted in an art that was conspicuously civil in its subject matter. For the Protestants, this was a manifestation of their independence from the Spanish Empire and the Vatican.

Intellectual context

In the 17th century, the Netherlands, and Amsterdam in particular, were prominent in the search for anatomical knowledge, which was thought to demonstrate God's wisdom when he created man.² The Calvinist Church did not stand in the way of this intellectual work. The same cannot be said of the Catholic Church, which in 1633 ordered that the 69-year-old Galileo be tried before the Roman Inquisition.

In Protestant countries, science was flourishing, with the invention in 1590 of the compound microscope by the Janssen brothers, and the microscope created by van Leeuwenhoek in 1668.³ In England, Thomas Willis dissected brains in 1664 and the seat of the soul was located in the nervous system.⁴ Descartes left France for Leiden in order to work freely. The Netherlands had cultural rather than military power; in the 17th century, one-third of all books were published in Amsterdam.⁵

The concept of death also differed from that of southern Italy, where it was understood to be a sudden occurrence: in northern Europe, the separation of body and soul was believed to develop as a gradual process. Executed criminals were also dissected, specifically because this was considered a further punishment to the body, which was believed to retain some vestigial human identity.⁶

Artistic context

Seventeenth-century Dutch art shows a devotion to portraiture, both private and public/corporate (*doelen*). Artists captured the moment, giving great importance to the institutions of the day.⁷ Group portraits were a very popular genre, becoming symbolic of the burgeoning middle class, which eventually replaced the church and the monarchy as patrons of art. It was also attractive socially to be seen in the company of powerful people; many would pay to appear in these group portraits in the same way as some do today with celebrity gossip shows.⁸ The artist was responsible for reconciling the interests

of all the paying participants, who would all want a privileged place.

The painter

Rembrandt Harmenszoon van Rijn was born on 15 July 1606 in Leiden,⁸ a centre of medical education at the time, to a large family of wealthy malt millers. In 1620 he enrolled at the University of Leiden, the country's oldest, but soon became bored and asked his parents' permission to leave the university and become a painter. At the age of 19, he was obsessed with old age: for him, proximity to death was equal to proximity to knowledge. Rembrandt studied the oft-neglected boundary between life and death, and is said to have been a regular visitor to the elderly refuge, where the residents would model for his paintings. He began to earn a reputation as a painter, and after the deaths of his father and brother in 1630 and 1631, respectively, he left for Amsterdam, where he could work on more complex pieces.

He married Saskia van Uylenburgh, daughter of the Burgomaster of Amsterdam and cousin to one of the city's most important art dealers. She represented an ideal of feminine beauty, and her face inspired many of his works. Rembrandt lived in a luxurious home and owned a large collection of antiques (the 17th century was a golden age for collectors), but his final years were marred by personal and financial ruin. Saskia died in 1642 while giving birth to their son Titus, Rembrandt became bankrupt in 1657, and 1662 saw the death of Hendrickje Stoffels, the maid who became his lover and who at the age of 36 gave him a daughter, Cornelia, in 1654.⁷ Titus also died in 1668, shortly after marrying. Rembrandt became increasingly withdrawn and spiritual, and eventually died in Amsterdam in 1669, aged 63.

The paintings (the *Anatomy lessons*)

Public dissections, which were almost theatrical in nature, began in Italian medical schools in the early Renaissance and had spread across the rest of Europe by the mid-16th century.^{8,9} Dissections took place in "anatomical theatres" (the Palazzo del Bo still houses the earliest, built in 1594 at the University of Padua); in addition to the scientific element, a dissection was a social occasion, a ritualised spectacle where entrance fees covered not only the *praelector's* payment but also a subsequent banquet hosted by the guild of surgeons,



Figure 1. *The anatomy lesson of Dr Nicolaes Tulp*, Rembrandt, 1632. Oil on canvas, 169.5 x 216.5 cm, Mauritshuis, The Hague, Netherlands

which was followed by a torchlit parade.¹⁰ There could be hundreds of spectators (up to 500), and the attending students, physicians, surgeons, and members of the general public were seated separately.

Unlike in Italy, Britain, or France, there were no scientific societies or journals in the Netherlands at the time; the anatomical theatres therefore served as venues for scientific meetings and debates. They often also housed libraries, study rooms, and even botanical gardens.

Dutch cities proudly held annual public dissections; until the 17th century, only male bodies could be used. The law only permitted the dissection of the bodies of those who had died by capital punishment or by suicide, or those of illegitimate birth; dissections had to occur within hours of death, hence the rarity of the practice.

Ordinances enacted in 1605 and 1625 to regulate dissections in Amsterdam explicitly prohibited the audience from speaking or laughing during dissections, although they were permitted to ask questions as long as these were of a “decent and serious nature.”

Dissections lasted approximately three days and were performed in winter to ensure better preservation of the body. As night fell, the theatre would be lit with scented

candles; it was also common for flute music to be played. The dissection table was located at the bottom of the theatre and surrounded by rows of seats, and wine and sweets would be available during the procedure. Some organs, such as the heart, kidneys, or liver, would be passed among the audience; it cannot have been rare for these to be stolen, as the government passed a decree establishing a six-florin fine for the theft of body parts from public dissections.¹⁰

Methods

The author performed a detailed analysis of the oil paintings *The anatomy lesson of Dr Nicolaes Tulp*, displayed at the Mauritshuis in The Hague (Netherlands), and the surviving fragment of *The anatomy lesson of Dr Deijman*, displayed at the Amsterdam Museum.

Results

The anatomy lesson of Dr Nicolaes Tulp

In January 1632, Rembrandt finally had the opportunity to paint the piece: a prisoner was executed and a body became available for dissection.

With *The anatomy lesson of Dr Nicolaes Tulp* (Figure 1), one of the most important paintings of his early career (it was his first large group portrait), Rembrandt was propelled to fame; the painting addresses the most famous medical subject matter for centuries.

The painting was commissioned by Amsterdam's guild of surgeons to a 26-year-old artist who had recently arrived in the city. Rembrandt's brother-in-law recommended him to Nicolaes Tulp¹¹; the public dissection immortalised in the painting was Tulp's second as *praelector*. The dissection served as an excuse to create an excellent group portrait.

This painting is the first that Rembrandt signed with his name rather than the initials RHL (Rembrandt Harmenszoon of Leiden); the painting is marked with the words "REMBRANDT. F[ecit]. 1632," showing the artist's personal evolution.

The protagonists are:

1. The professor

Nicolaes Pieterszoon (1593-1674), alias Dr Tulp (for the tulip motif decorating the façade of his Keizersgracht mansion), was born in Amsterdam to a family of wealthy Protestant merchants. He graduated from the University of Leiden in 1614, specialising in the digestive system (he was the first person to identify the ileocecal valve); in 1639, he discovered human lymphatic vessels (*vasa lactea*), which Aselli had described in dogs in 1622.¹² In 1652 he described spina bifida, wrote a well-known treatise on monsters, and studied primatology (his was the first description of a chimpanzee in Europe); he also wrote a large part of the official Dutch pharmacopoeia. However, his main vocation was politics: he worked in many public roles (serving as a councillor in 1622, as a judge, as Burgomaster of Amsterdam several times, and as city treasurer seven times, etc); as a surgeon, he was appointed *praelector chirurgi et anatomiae* (head anatomist) by the Amsterdam guild of surgeons between 1628 and 1653. This position involved directing the annual public dissection.

2. The students

The painting has been restored 21 times (the last being in 1998); we know the names of the seven students because when the painter Jurian Pool restored it in 1800, he added their names to a page held by one of the students,

immortalising them; previously, it featured a drawing of a forearm.^{12,13}

The students' names are Jacob Block (the man shown looking at Tulp's fingers and the book at the cadaver's feet), Hartman Hartmanszoon (holding the page with the names), Adraen Slabran (looking at the book), Jacob de Witt (observing Tulp's manipulation of the muscles), Mathijs Kalkoen (concentrating on the movements of Tulp's left hand), Jacob Koolvelt (shown in profile at the left, a posterior addition to the scene), and Frans van Loenen (who is shown pointing at the cadaver, as if to remind us of human mortality). The concept of mortality is reinforced by the appearance of the cadaver's face: the painting shows a dead man, not a *subiectum anatomicum*.

This sober atmosphere, with the students' elaborate dress, Tulp's wide-brimmed hat (symbolising his intellectual authority), and the feast that would follow the dissection, which was also in some sense symbolic, transmits the fact that this was somehow more than merely an anatomy lesson.

These portraits seem almost to portray a latent conflict between fascination and fear at the mysteries concealed within the human body.

3. The cadaver

The cadaver depicted is that of Adriaen Adriaenszoon, alias Aris Kindt ("the child"), a 41-year-old man from Leiden who had been found guilty of the violent robbery of a citizen of Amsterdam, with the aggravating circumstances of its being a repeat offence and assaulting a warden at the prison in Utrecht; he was executed the same day. After a public hanging, the hangman would immediately lower the body, not only to prevent decomposition and defilement by birds of prey, but also to protect it from the voracity of the assembled public: people attributed magical or healing powers to the bones and bodily fluids of the executed person.

4. The scene: Dutch Baroque art in the early 17th century

Dr Tulp is shown giving an anatomy lesson on the left upper limb of the cadaver, which was carefully cleaned and transferred to a building on Nieuwmarkt Square in Amsterdam.⁵

One of Rembrandt's aims was to dignify surgery as a profession; this is compatible with the Protestant ideology, which encouraged scientific research and logical thought.

Rembrandt clearly draws influence from tenebrism, creating a simple background which does not distract from the scene and portraying the subjects with monochromatic clothes, contrasting with their white cuffs and collars. The cadaver's forearm is already dissected, for which reason the professor uses only a forceps to give his lesson; a large book (whose title is not shown) can be seen to the right of the scene, at the cadaver's feet.

The cadaver lies on a diagonal between the book and the student in the upper left corner, conferring a sense of depth; its position and brilliance (light seems to emanate from the pallid body, increasing the scene's drama), reinforced by a zenithal light source from the right, make it the centre of attention. This diagonal is balanced by the triangular shape described by the students (rather than a row, as was typical), bringing the ensemble a classic sensation of unity and balance, without the rigidity characteristic of earlier periods. The image has a certain dynamism and naturalism, drawing from the interplay of the characters' gazes in different directions; the combination of all these characters is needed to counterbalance Tulp's omnipotent figure.

Rembrandt painted a group exuding moral and psychological unity, while preserving each figure's individual expression.¹⁴ The remarkably realistic expressions on the students' faces contribute to the great accuracy of these individualised portraits. Rembrandt masterfully studies each character's soul, trying to show their inner movement, their emotions and their thoughts, through their body language.

The cadaver's posture is similar to that of the "Dead Christ": pallid, with its face partly shaded, suggesting *umbra mortis* (shadow of death); Rembrandt used this technique on a number of occasions. The purpose of the cadaver is to light the central area of the canvas.¹⁵

From the cadaver, the spectator's gaze rises to the students' illuminated faces, then to the face and hands of Dr Tulp, who looks beyond the group of students. The diverse gazes draw us into Tulp's lesson, making the theatre expand to contain the room where the painting is displayed, impregnating the atmosphere with the triumph of science over death.

Rembrandt's characters tend to appear radiant; paradoxically, much of the light in this piece emanates from the dead body. The contrasted lighting in the

painting creates degrees of life (the dead and the living, from bottom to top) and intellect (the master and the students, from right to left). However, Rembrandt does not use harsh lighting, with sharp lines separating light and dark areas, as seen in Caravaggio's work; his is paler, with a more gold or silver tone, creating an atmosphere full of nuances and transitions.

We may also make a spiritual reading of the scene: the postures and facial expressions of the students markedly resemble those of characters shown listening to Jesus Christ.

The only colour that seems to break free from the chiaroscuro of the canvas is the red of the cadaver's arm, apparently the main reason for the scene, which is painted with an anatomical precision possibly copied from a textbook.¹⁶

Dr Tulp is shown seated, his left hand mimicking the movements he achieves in the cadaver's hand via the muscles of the forearm (specifically, the flexor digitorum superficialis).

He holds a pair of forceps, which is unusual as a pointer would habitually be used to signal different body parts. The reason for this is that he is demonstrating a function rather than an anatomical structure; this interpretation is supported by the fact that while one student studies the cadaver's forearm, another is seen looking carefully at the professor's left hand, which copies the movements achieved by manipulating the muscle. This may imply that Rembrandt painted two sequential moments of the same action. This is a lesson not in static anatomy, but in functional anatomy. Precisely this idea, movement, is one of the characteristic features seen in Rembrandt's work.

In addition to muscular and tendinous structures, such as the flexor digitorum superficialis and profundus, flexor carpi ulnaris, and abductor digiti minimi muscles, and the flexor pollicis longus tendon, Camper chiasm, and a possibly displaced epitrochlear muscle, the dissected limb also shows such nervous structures as the medial branch of the proper palmar digital nerve of the thumb, originating from the median nerve, and a possible anatomical variation of the ulnar nerve, with the ulnar branch of the proper palmar digital nerve of the little finger originating from the dorsal branch.

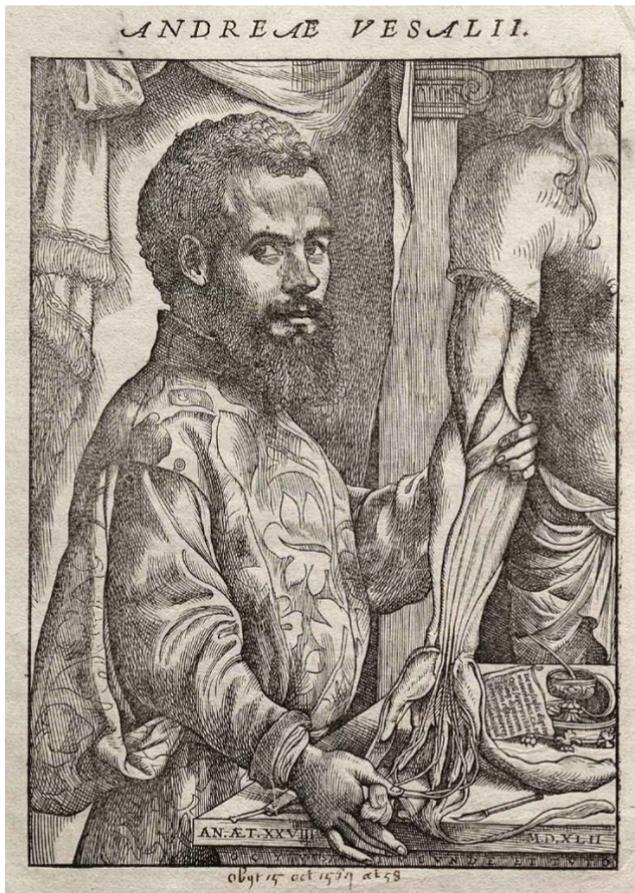


Figure 2. Portrait of Vesalius from his book *De humani corporis fabrica libri septem*, 1543

It appears that Tulp, in Rembrandt's portrayal, demonstrates how understanding is born of experience. This was the belief of the artist, with his great tendency to make endless notes on the objects and models he painted.

The painting was due to be sold in 1828 for the benefit of the surgeons' widows' fund; eventually, King William I bought it to enrich the "Royal Cabinet of Paintings."

The piece was restored several times, and radiography studies have revealed changes made during the painter's lifetime. At least two of the students and the list of names were added after the completion of the original work.¹⁷

The image contains a number of anatomical anomalies:

1. To temper the unpleasant smell, autopsies and dissections would be performed in winter, as the cold slowed the decomposition of the cadaver. The abdomen

(containing the most rapidly decomposing organs) would be opened first, followed by the thorax, then the head, and finally the limbs. However, this is not the case in Rembrandt's painting, either by mistake or at the request of Tulp, who would thus be remembered as a successor to Vesalius: the latter is depicted beside an arm without skin on the frontispiece of his book *De humani corporis fabrica* (Figure 2).

2. There are errors of perspective in the cadaver, which is an otherwise perfect nude study. The head is disproportionate and misaligned with respect to the trunk, due to the attempted foreshortening effect.

3. The dissected left arm is longer than the right, as is the hand; this has led to the theory that the model used was from a different cadaver or that the image was taken from an anatomy atlas.¹⁸ Some commentators believe that the dead man's arm was dissected as a symbolic punishment for his crime (mortification of the flesh of the offending hand, even after execution), recalling an act of penitence.

4. The flexor digitorum superficialis muscle originates from the medial epicondyle, ulna and radius, rather than the lateral epicondyle. There are several possible explanations as to why this was not corrected, as both Rembrandt and Tulp would have recognised it. Tulp, having seen the painting, would have recognised the error and may have decided for some reason to accept it.¹⁵ Another theory is that Rembrandt misinterpreted a drawing by Vesalius, mistaking a right for a left arm.¹⁹

5. The preparator is absent: in the 17th century a prestigious scientist like Tulp would not have intervened in the menial, bloody work of the dissection, which would be left to others. This explains the absence of cutting tools.

The anatomy lesson of Dr Deijman

Rembrandt's second, less famous anatomy lesson painting, *The anatomy lesson of Dr Deijman* (Figure 3), was created in 1656. The painting was also commissioned for the Amsterdam guild of surgeons, by Dr Joan Deijman (1619-1666), to be exhibited in his anatomy room. This scene is without a doubt the most famous depiction of a neuroscientific procedure.²⁰

Deijman succeeded Tulp in 1653 as the head anatomist of the Amsterdam guild of surgeons. In 1656, he substituted Arnold Tholinx as the inspector of the Medical Colleges of Amsterdam; the event was immortalised by Rembrandt,

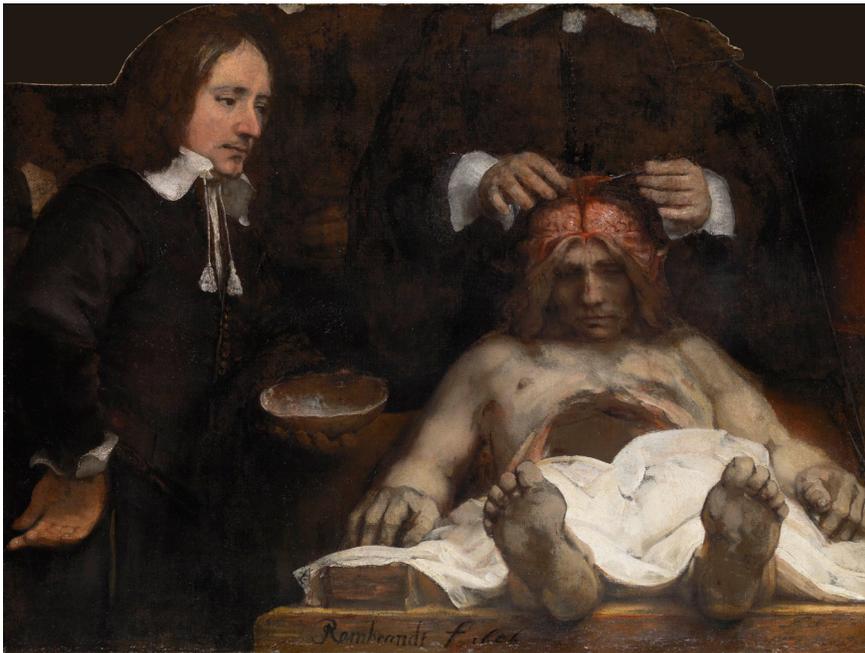


Figure 3. *The anatomy lesson of Dr Deijman*, Rembrandt, 1656. Oil on canvas, 100 x 134 cm, ©Amsterdam Museum, Amsterdam, the Netherlands

who continued to enjoy great artistic prestige despite his dire personal and financial situation at the time. The artist, an acquaintance of Tholinx and his colleague Tulp, accepted the commission.

The painting shows Dr Deijman (who on 29 February 1656 taught the first session of an anatomy lesson lasting three days) dissecting a brain in an anatomical theatre. Beside Deijman, an assistant (master of the guild) holds the cranial vault. The face of Gijsbert Kalkoen (1621-1664), son of Matthijs, one of the protagonists in *The anatomy lesson of Dr Nicolaes Tulp*, is the only one visible in the fragment. It appears that two *proefmeesters* (chairs of the examination board for aspiring surgeons) and four *overlijden* (full members of the guild) also attended.

Dr Deijman received six silver spoons (worth just over 31 florins at the time) for these sessions.

Today, only the bottom central part of the original canvas (113 × 135 cm) is preserved, due to severe damage from a fire in 1723. The painting, subsequently lost and rediscovered in England in the 19th century, was recut across the top and lateral edges.²¹ The piece was initially hung in the anatomical theatre in Amsterdam, then moved in 1690 to the lounge of the guild of surgeons in the Nieuwe

Waag. From the 19th century, it was in the hands of an English collector, then bought by the city of Amsterdam in 1882; today, it is exhibited in the Amsterdam Museum. At its original size, it must have been an overwhelming sight.

A sketch preserved at the Rijksprentenkabinet in Amsterdam, used as a study for the shape of the frame, seems to indicate that the scene originally featured seven or eight figures. The sketch shows a balanced, symmetrical composition with lines leading to the characters in the foreground.

The cadaver is laid immediately before the spectator, with pronounced foreshortening. The dissection table almost protrudes from the painting; at its head stands Dr Deijman, whose face was removed when the painting was recut. The composition is reminiscent of the *Lamentation over the dead Christ* (1500) by the Italian painter Andrea Mantegna (Figure 4): the position and perspective of the cadaver and the dark background are similar in both pieces.²²

The anatomy lesson of Dr Deijman is more realistic than the Dr Tulp painting, with the abdomen being opened and eviscerated before the head was dissected, in accordance with the usual practice.



Figure 4. *Lamentation over the dead Christ*, Andrea Mantegna (c. 1480), 38 x 81 cm. Pinacoteca de Brera, Milan, Italy

Having made a horizontal cut and removed the cranial vault (shown in his assistant's hands), Deijman is shown using his forceps to separate the dura mater as though opening a holy book. We can see how the dura mater enters the space between hemispheres, forming the falx cerebri. This image would seem clearly to be influenced by certain Vesalius engravings, specifically engraving 67:2 from *De humani corporis fabrica* (1543).²³ As was habitual, the posture of the cadaver is forced (hyperflexion) to enable the spectators to see, explaining why the head appears to be disjointed with respect to the trunk; the trauma caused when the prisoner was hanged would also favour such a posture.

The anatomy lesson served as an excuse for Rembrandt to complete the institutional commission for a group portrait. While the most important element of *The anatomy lesson of Dr Tulp* are the characters' faces, here the dissection also takes a central role.

The image invites us to reflect on death and the soul: the brain was thought (though not by all) to be the seat of knowledge, that which makes us human. We may even appreciate a certain symbolism in the falx cerebri,

which resembles a sickle; this symbol is often associated with the characterisation of death, which represents the ephemeral nature of existence.²⁴

Like in *The anatomy lesson of Dr Nicolaes Tulp*, Rembrandt uses chiaroscuro, with light falling on the cadaver; however, he also incorporates a novel element: the softer brushstrokes give a sensation of the air, an "atmospheric effect" caused by the dust that would be found in an enclosed space.

In the anatomy book resting on the table we can read the following:

On January 28th, 1656, the criminal Joris Fonteijn of Driest was executed by hanging and his body was handed over by the Court of Justice to the Surgeons' Guild for anatomic dissection. On the 29th, Dr Jan Deijman gave his first demonstration in the theatre of Anatomy, in three consecutive sessions.

The aforementioned Joris Fonteijn (1633/34-1656), alias Black Cat, was a "habitual offender" and was found guilty on 17 January 1656 of robbing a textiles store, threatening those present with a knife.

Discussion

The two *Anatomy lessons* were painted 24 years apart, displaying an intellectual and even an emotional separation between the young artist faced with his first large project and a mature work, which is more introspective and spiritual and of greater anatomical accuracy.

Developments in anatomical knowledge (as portrayed by Rembrandt) gave rise to the contemporary Western dualism of man and body; the body is granted the privilege of scientific interrogation by the physician through specific questioning, regardless of any other point of reference (the soul, society, emotion, etc).²⁵ This results in a well-known contradiction for any form of medicine: who becomes ill, the man or his organs? And who should we cure, the patient or the illness?

Conflicts of interest

This work has not been presented at any congress or conference and has received no funding.

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