The Anatomy Lesson of Dr. Nicolaes Tulp by Rembrandt (1632): A Comparison of the Painting With a Dissected Left Forearm of a Dutch Male Cadaver

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Rembrandt's *The Anatomy Lesson of Dr. Nicolaes Tulp* (1632) is considered a masterpiece and is a group portrait of the Amsterdam Guild of Surgeons in the form of an anatomy lesson. Dr. Nicolaes Tulp, Doctor of Medicine and Praelector Anatomiae to the Amsterdam Guild of Surgeons, showed an anatomic dissection of a forearm on the corpse of an executed criminal. The anatomic accuracy in Rembrandt's famous painting has been discussed in the literature for decades without any general consensus. In 2006, on the 400th anniversary of Rembrandt's birth, a forearm dissection of a cadaver and a comparison with the anatomy in the painting are presented to analyze the anatomic accuracy of Rembrandt's famous painting. (J Hand Surg 2006;31A:882–891. Copyright © 2006 by the American Society for Surgery of the Hand.)

Key words: Amsterdam Guild of Surgeons, forearm dissection, Nicolaes Tulp, Rembrandt, 17th century.

Almost 4 centuries ago Rembrandt painted a group portrait of the Amsterdam Guild of Surgeons in the form of an anatomy lesson. The painting, dated 1632, known as *The Anatomy Lesson of Dr. Nicolaes Tulp*, should be placed within the tradition of anatomy paintings from the Guild, which began in 1601 and extended far into the 18th century.[1] The painting is considered a masterpiece because Rembrandt seemingly created a realistic representation of an anatomy lesson and abandoned the traditional formal and stiff arrangement of figures. Dr. Nicolaes Tulp, Doctor of Medicine and Praelector Anatomiae to the Amsterdam Guild of Surgeons, showed the dissection of a forearm (Fig. 1). To Dr. Tulp's right side 7 members of the Guild are seated.[2] The Guild members' facial expressions and visual directions emphasize in a masterly way the climax of Dr. Tulp's demonstration.[2] The gesture of Dr. Tulp's left hand illustrates the function of the muscles in the forearm and lends weight to his demonstration.[2] Therefore, Tulp's pose is that of a man who is speaking to teach, and the members of the Guild are listening to learn.[2] Tulp presumably took the initiative to have himself painted with a group of Guild members in the tradition of his predecessors during the anatomic dissection, held on January 31, 1632, of the corpse of a 28-year-old executed criminal named Adriaan Adriaansz, alias Aris 't Kint (January 31, 1632).[1–3,5–13] Currently the painting is shown in the Royal Picture Gallery Mauritshuis in The Netherlands.

Public Anatomic Lessons in the 17th Century

From the beginning of the 16th century onward public anatomy lessons developed and spread across Europe.[3] By the end of the century public anatomy lessons were presented in many medical centers in Europe.[3] In 1555 the Amsterdam Guild of Surgeons was granted the privilege of dissecting the body of an

Figure 1. Rembrandt's painting (1632) *The Anatomy Lesson of Dr. Nicolaes Tulp*. Reprinted with permission from Foundation Friends of the Mauritshuis, The Netherlands.

executed criminal to teach anatomy.[5–7] The Praelector, which literally means *reader in anatomy*, was elected by the city from among the physicians in the city and would teach osteology, physiology, surgery, and zoology twice a week.[1] Public anatomic demonstrations were given by the Praelector and were organized by the Guild once a year.[1] Usually each lesson would take longer than 1 day and the lessons were held during the winter season so the corpse would remain in relatively good condition because of the low temperatures.[1,5] An anatomic theater of the 17th century was designed to accommodate 200 to 300 people.[3,14] Even when no anatomic lesson was held visitors were able to view the interior of the theater with human and animal skeletons set up on the gallery.[1,14] Public anatomic lessons were accessible not only to members of the Guild but also to local citizens.[1] Visitors paid admission to join the event.[1] It is clear from the anatomy book of the Guild, which lists the public anatomic lessons held between 1631 and 1731, that they were popular events in Amsterdam.[1] Rembrandt's *The Anatomy Lesson of Dr. Nicolaes Tulp* is considered the culmination of a series of events: the public execution of a criminal, the public anatomic dissection of the corpse of a criminal hanged the day before, followed by a Guild banquet and a torch parade.[3] Public anatomic lessons were established initially for educational reasons, although by the end of the 16th century they had evolved into popular events for the citizens.[1]

Dr. Nicolaes Tulp

Dr Nicolaes Tulp was born as Claes Pietersz in 1593[1] and he eventually studied medicine at the University of Leyden.[1] The burial register on the death of one of his children refers to a signboard with a tulip at his house.[1] He choose a tulip for a coat of arms and the name "Tulp" became his family name.[1] After his tenure as Praelector Anatomiae of the Amsterdam Guild of Surgeons (1628–1653), Dr. Tulp was involved in politics later in his career and served as both city councilor and burgomaster of Amsterdam.[1] In his medical career Tulp developed the first *Pharmacopoea Amstelredamensis*, a book with descriptions for medication, as a result of the desperate situation in 1635 when Amsterdam was besieged by the plague and many people died as a result of incorrectly prepared medication.[1,5–7] Tulp's most impressive achievement in the medical field was writing the book *Observationes Medicae*, which contains definite descriptions of the conditions, treatment, and recovery or cause of death of 231 patients.[1] He wrote about various forms of cancer, the connection between tobacco smoking and lung diseases, stones, a heart clot, palpitations, a head injury, loose skin, cerebral palsy, and even a 2-headed person.[1] Tulp was the first person to describe and draw the valvula ileocecalis accurately.[1]

Presumed Anatomic Errors in Rembrandt's Painting

The presumed mistakes in the anatomy of the dissected forearm in Rembrandt's famous painting *The Anatomy Lesson of Dr. Nicolaes Tulp* (1632) have been discussed in medical and art-history literature for decades[1–5,8,9,11–13,15–28]; however, there is still no general consensus about the observed structures in the dissected human forearm. In addition most viewpoints are based on comparisons of the painting with anatomic atlases, not with a dissected forearm of a human cadaver. The discussion about presumed anatomic errors in Rembrandt's painting was initially based on the question of whether the flexor or extensor muscles are represented.[4] This is because the origin of the muscles that Dr. Tulp is holding in the forceps seems to appear from the lateral epicondyle of the humerus; however, the flexor muscles of the forearm originate from the medial epicondyle of the humerus. In 1944 Wood Jones[16] stated that Rembrandt had drawn the superficial flexor muscles of the right arm and transferred them to the left arm. The lateral epicondyle is the origin of the extensor muscles of the forearm; therefore Heckscher[4] argued that the painting represents extensor muscles. Wolf-Heidegger[17] concluded in 1967 that the flexor muscles are represented. The intersection of superficial and deep flexor tendons, named *Camper's*

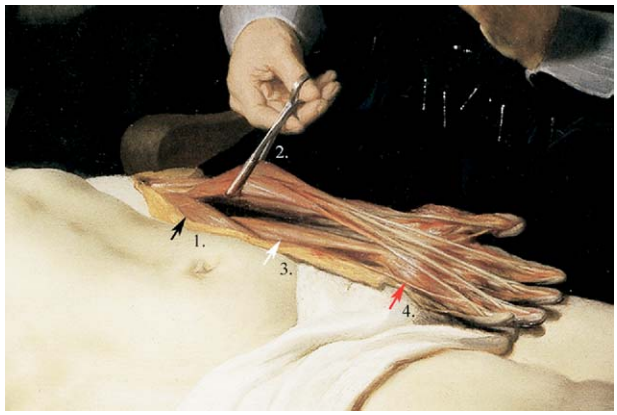

Figure 2. Dissected forearm as depicted in Rembrandt's painting marked with 4 different areas of anatomic structures that have been discussed in the literature. Black arrow, sloping muscle; white arrow, single muscle belly situated between the elbow and the wrist; red arrow, longitudinal cord-like white structure.

chiasma, is visible clearly on the digits.[9,18,19] Four anatomic areas in Rembrandt's painting were discussed mainly in the literature (Fig. 2): the sloping muscular structure that is prominent on the ulnar side of the proximal aspect of the forearm (area 1), the muscular structures in Dr. Tulp's forceps (area 2), the long straight muscular structure lying between the elbow and the wrist on the ulnar side (area 3), and the longitudinal cord-like white structure situated at the ulnar part of the small finger (area 4).[1–5,8,9,11–13,15–28] Carpentier Alting and Waterbok[18,19] reported in 1976 that the anatomy in the painting could be reproduced by lifting the flexor digitorum superficialis together with the flexor carpi radialis muscle in the forceps. In 1982, the 350th anniversary of the painting, the editor of this *Journal* challenged readers to identify the anatomic error (the origin of the flexor muscles from the lateral epicondyle) in the painting.[15] In 2006, the 400th anniversary of Rembrandt's birth, we present this study to investigate the accuracy of the anatomy depicted in the painting by comparing the painting with the dissected forearm of a male cadaver.

Anatomic Comparison of the Painting With a Cadaveric Dissection

One left forearm from a 41-year-old preserved male cadaver was dissected at the Department of Anatomy at the University of Groningen in The Netherlands. The arm was positioned and the skin was removed according to Rembrandt's painting *The Anatomy Lesson of Dr. Nicolaes Tulp*. Muscles and tendons on the volar aspect of the forearm were isolated along with the lower arm nerves. Pictures were taken at every stage of dissection. The anatomic areas (Fig. 2), which were discussed mainly in the literature, were analyzed according to the following 4 stages. In the first stage the anatomic structures in Rembrandt's original painting at the Royal Picture Gallery Mauritshuis were observed and described without interpreting them. In the second stage a forearm dissection was performed as described earlier and the anatomic structures in the cadaver were observed and described. In the third stage the anatomic structures of the painting were compared with the dissected forearm and analyzed. A detailed illustration of the dissected forearm in the original painting was used for comparison during the anatomic dissection. In the fourth stage different approaches were used to reproduce the anatomy as depicted in Rembrandt's painting Several structures were dissected and transferred for this purpose.

Area 1

Rembrandt's painting shows a sloping muscle on the ulnar proximal side of the forearm (Fig. 2, black arrow). It is a separate muscle belly that seems to originate from the medial epicondyle. Its insertion is partially covered by dissected skin. Once the forearm was dissected there was no sloping muscle observed as seen in the painting (Fig. 3A).

Because normally there is no muscular structure in this area we tried to transfer some superficial flexor muscles to reconstruct area 1 similar to the painting. Some investigators[17–19] believe the sloping muscle to be the palmaris longus muscle. The palmaris longus muscle is a slender fusiform muscle situated ulnar to the flexor carpi radialis muscle. It originates from the medial epicondyle of the humerus and courses as a long tendon to insert at the palmar aponeurosis. The palmaris longus muscle was cut at the insertion and transferred to the ulnar side of the forearm. A muscle that was thin, flat, and not equal in bulkiness compared with the sloping muscle in the painting was shown (Fig. 3B).

The flexor carpi radialis muscle is situated ulnar to the pronator teres muscle and arises from the medial epicondyle. Its muscle belly is fusiform and forms a cord-like tendon to the wrist. The palmaris longus and flexor carpi radialis muscle insertions were cut and transferred to the ulnar side of the forearm. An almost equal amount of muscle tissue was created, comparable with the amount of muscle tissue visible in the painting (Fig. 3C). Removal of the palmaris longus muscle from the transferred muscle mass did not reduce the muscle volume substantially.

The pronator teres muscle has been suggested by some investigators[20–22] to be the sloping muscle;

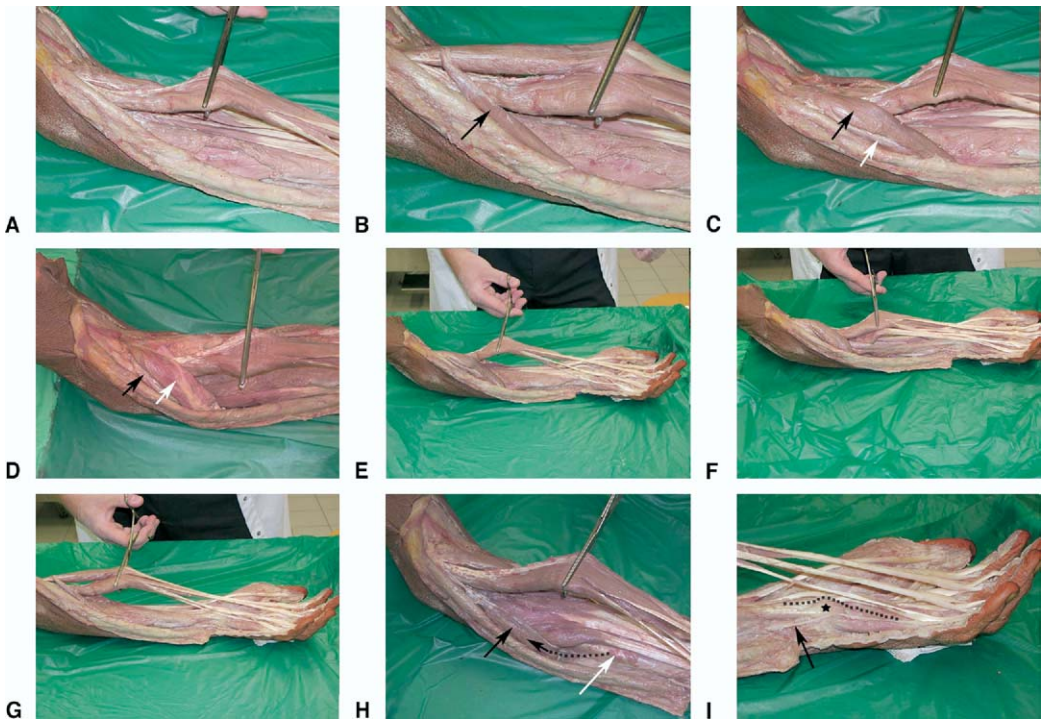

Figure 3. (A) No sloping muscle is observed on the ulnar proximal side of the dissected forearm. (B) The palmaris longus muscle is cut at the insertion and transferred to the ulnar side of the forearm in an attempt to recreate the sloping muscle in the painting. The flexor digitorum superficialis and the flexor carpi radialis muscles are held in the forceps. Arrow, palmaris longus muscle. (C) The palmaris longus and the flexor carpi radialis muscles are cut and transferred to the ulnar side of the forearm in an attempt to reconstruct the sloping muscle in the painting. Black arrow, flexor carpi radialis muscle; white arrow, palmaris longus muscle. (D) The pronator teres, flexor carpi radialis, and palmaris longus muscles are cut at their insertion and transferred to the ulnar side of the forearm in an attempt to recreate the sloping muscle in the painting. Black arrow, flexor carpi radialis and palmaris longus muscles; white arrow, pronator teres muscle. (E) The flexor digitorum superficialis muscle is held in the forceps. To lift the flexor digitorum superficialis muscle the insertion of the flexor carpi radialis and the palmaris longus muscles were cut. These muscles are transferred to the ulnar side of the forearm to recreate the sloping muscle in the painting. (F) The flexor digitorum superficialis and the flexor digitorum profundus muscles are held in the forceps together, with the flexor carpi radialis and the palmaris longus muscle transferred to the ulnar side of the forearm. (G) The flexor digitorum superficialis and the flexor carpi radialis muscles are held in the forceps. The palmaris longus muscle is transferred to the ulnar side of the forearm in an attempt to recreate the sloping muscle in the painting. (H) The insertion of the flexor carpi ulnaris tendon is cut and transfer of the muscle belly to the proximal forearm with regard to its normal position exposes the ulna. Black arrow, transferred flexor carpi ulnaris muscle; white arrow, ulna; dotted line arrow, transfer direction of the flexor carpi ulnaris muscle. (I) Initially no longitudinal cord-like white structure was observed at the ulnar part of the small finger. To reproduce the white structure in Rembrandt's painting a distal branch of the ulnar nerve is transferred to this area. Arrow, ulnar nerve; star, pisiform; dotted line, standard course of the ulnar nerve.

however, Bankl and Bankl[20] stated that this is most likely the pronator teres muscle of the right arm and that it does not exist in this way in the left arm. The pronator teres muscle is situated at the radial part of the cubital region and passes obliquely across the forearm to insert on the lateral surface of the radius. The pronator teres muscle was cut at its insertion on the radius and transferred to the ulnar side of the forearm along with the flexor carpi radialis and palmaris longus muscles (Fig. 3D). Because of their common origin these 3 muscles had to be transferred together. The volume of the transferred muscle mass in the dissection was much greater than the appearance of the muscle mass in the painting.

According to Schupbach[2] the sloping muscle should be the flexor carpi ulnaris muscle and the palmaris longus muscle is not shown in the painting because it is absent in many human beings and, when present, it often comes off with the skin during dissection. The flexor carpi ulnaris muscle is the most ulnar-situated muscle of the superficial forearm flexors. It arises by 2 heads from the medial epicondyle of the humerus, the olecranon, and the posterior border of the ulna. A thick tendon forms its distal half and is attached to the pisi-

form, hamate, and fifth metacarpal bone. Transfer of the flexor carpi ulnaris muscle resulted in complete exposure of the ulna. Because an exposed ulna was not evident in Rembrandt's painting the flexor carpi ulnaris is not likely the sloping muscle.

It must be concluded that no muscular structure is observed at dissection as seen in area 1 on Rembrandt's painting. The presentation in the painting was represented most accurately by transferring the flexor carpi radialis muscle with or without the palmaris longus muscle. To elevate the flexor digitorum superficialis muscle out of its natural bed with the forceps (as depicted in the painting) the insertion of the flexor carpi radialis muscle has to be cut. It is likely that Dr. Tulp transferred the flexor carpi radialis muscle to lift the flexor digitorum superficialis muscle and created the sloping muscle as seen in the painting (Figs. 3C, 4).

Area 2

The structures held in Dr. Tulp's forceps consist of several muscle bellies (Fig. 2). The most radially situated superficial muscle belly leads to an index finger tendon. Tendons to the middle and ring fingers originate from muscle tissue centered between the forceps. The most ulnar superficial muscle belly leads to a small finger tendon. None of the depicted tendons cross each other; they run straight toward Camper's chiasm of each digit.

The muscle in the forceps is believed to be the flexor digitorum superficialis muscle.[2,16] Other muscles that have been proposed are the flexor carpi radialis together with the flexor digitorum superficialis muscle.[18,19] The flexor digitorum superficialis muscle is situated deep to the flexor carpi radialis, palmaris longus, and pronator teres muscles. It is the largest of the superficial flexors and arises from 2 heads. The ulnohumeral head arises from the medial epicondyle of the humerus and the coronoid process of the ulna. The radial head originates from the proximal half of the anterior border of the radius. The flexor digitorum superficialis muscle gives rise to the tendons to the index through small fingers. To lift the flexor digitorum superficialis muscle in our forceps we had to cut the insertion of the flexor carpi radialis and palmaris longus muscles (Fig. 3E). Dissection showed that the tendons originate at different levels from the flexor digitorum superficialis muscle bellies. Tendons from the more

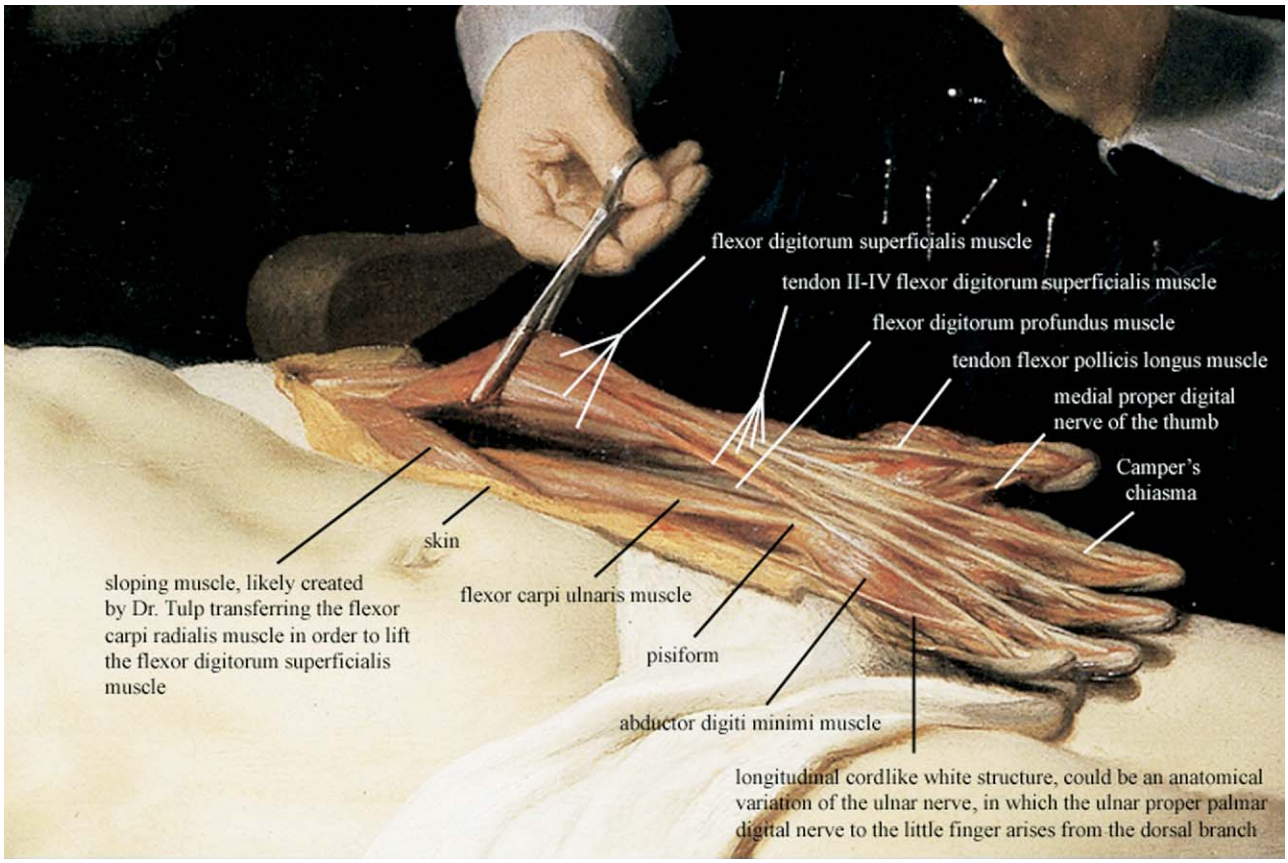

Figure 4. Dissected forearm in the painting with identification of the anatomic structures.

volar bellies of the flexor digitorum superficialis muscle pass to the middle and ring fingers whereas tendons from the deeper flexor digitorum superficial muscle bellies pass to the index and small fingers. In the painting, however, tendons from the more volar bellies of the flexor digitorum superficialis muscle pass to the index and small fingers instead of to the middle and ring fingers and tendons from the deeper bellies of the flexor digitorum superficialis muscle centered between the forceps pass to the middle and ring fingers instead of to the index and small fingers (Figs. 3E, 4). The same observation was made by Wolf-Heidegger and Cetto[17]

In the painting more muscle volume in the forceps is observed than would be anticipated from the flexor digitorum superficialis muscle alone (Figs. 2, 3E). To recreate more muscle volume the flexor digitorum superficialis and the flexor digitorum profundus muscles were held in the forceps together (Fig. 3F). The flexor digitorum profundus muscle arises deep to the superficial flexors from the anterior and medial surface of the ulna and from the interosseous membrane. The muscle ends in 4 tendons that initially run inferior to the tendons of the flexor digitorum superficialis muscle and the flexor retinaculum. In the hand the flexor digitorum profundus tendons pass through the tendons of the flexor digitorum superficialis muscle (Camper's chiasm) to insert on the distal phalanges. The flexor digitorum superficialis and the flexor digitorum profundus muscles together in the forceps resulted in greater bulkiness of muscle tissue but also exposed the tendons of the flexor digitorum profundus muscle, which are not seen in the painting.

Previous publications[18,19] have proposed that the flexor digitorum superficialis together with the flexor carpi radialis muscle are held in Dr. Tulp's forceps, with the palmaris longus muscle as the sloping muscle at the ulnar proximal side of the forearm. Recreating this situation in the dissection did not result in the anatomic appearance depicted in Rembrandt's painting (Fig. 3G).

The muscle in Dr. Tulp's forceps seems to be an enlarged volume of the flexor digitorum superficialis muscle alone (Fig. 4). Furthermore dissection showed that the tendons of the flexor digitorum superficialis muscle originate at different levels from the muscle bellies compared with the painting. The position of the index/small finger muscle bellies and the middle/ring finger muscle bellies of the flexor digitorum superficialis muscle are reversed in the painting compared with the anatomic dissection.

Area 3

Area 3 in Rembrandt's painting represents a single muscle belly situated between the elbow and the wrist (Fig. 2, white arrow). Its origin is covered by the sloping muscle and its insertion, consisting of a single tendon, is heading toward the ulnar aspect of the wrist.

There is debate as to whether the long straight muscle is the flexor digitorum profundus[2] or the flexor carpi ulnaris.[18,19] At dissection the flexor carpi ulnaris is the first muscle to be seen at the ulnar side of the forearm. It courses from the medial epicondyle to the pisiform. Cutting the insertion of the flexor carpi ulnaris tendon and transferring the muscle belly to the proximal forearm with regard to its normal position will expose the ulna (Fig. 3H). The flexor digitorum profundus muscle is situated radially from the flexor carpi ulnaris muscle and courses to the digits. Because the exposed ulna is not seen in the painting the single muscle belly in area 3 of Rembrandt's painting is the flexor carpi ulnaris muscle (Fig. 4).

Area 4

As observed in Rembrandt's painting a longitudinal cord-like white structure appears proximally at the level of the distal forearm and courses to the ulnar part of the small finger (Fig. 2, red arrow). This longitudinal cord-like white structure has a slightly smaller diameter compared with the tendons of the flexor digitorum superficialis but shares a similar color.

The structure has been proposed to be the dorsal sensory branch of the ulnar nerve,[18,19] although Schupbach[2] believed the structure to be the superficial sensory branch of the ulnar nerve. At dissection no longitudinal cord-like white structure was observed as shown in the painting resembling a nerve or tendinous structure. It is not the flexor digitorum profundus tendon to the small finger because that tendon is much larger in diameter and is situated in a different position than the longitudinal cord-like structure depicted in the painting. The ulnar nerve is normally situated radially from the pisiform and the insertion of the flexor carpi ulnaris muscle and is covered by a slip of the flexor retinaculum. The dorsal sensory branch of the ulnar nerve passes over the dorsum of the hand and is not visible from the volar aspect of the hand. With regard to the location of the ulnar nerve at dissection the longitudinal cord-like white structure on the painting could not be a branch of the ulnar nerve following its standard course (Fig. 4).

To reproduce the longitudinal cord-like white structure in the painting we had to cut the ulnar nerve at the wrist and transpose its distal branch to the ulnar side of the pisiform (Fig. 3I). It seems highly unlikely that Dr. Tulp transferred a nerve to recreate the longitudinal cord-like white structure as seen in the painting. Therefore it must be concluded that the longitudinal cord-like structure in the painting represents an anatomic variation of a branch of the ulnar nerve.

Discussion

The most apparent and well-known anatomic error in Rembrandt's painting *The Anatomy Lesson of Dr. Nicolaes Tulp* is that the flexor muscles that Dr. Tulp is holding in the forceps seem to originate from the lateral epicondyle of the humerus.[9,16,18,19,24] The forearm is extended and supinated with the wrist placed in the groin.[18,19] The medial epicondyle of the humerus points to the corpse.[18,19] The lateral epicondyle of the humerus is turned away from the corpse in this position and therefore is not visible in the painting.[18,19] Dr. Tulp shows the flexor muscles of the forearm that originate from the medial epicondyle of the humerus The intersection of superficial and deep flexor tendons is clearly visible on the digits.[9,18,19] The assumed anatomic error about the lateral epicondyle of the humerus as the origin for the flexor muscles in Dr. Tulp's forceps should be abandoned with regard to the position of the dissected forearm in the painting. Dissection of the forearm of a male cadaver showed 4 anatomic differences compared with Rembrandt's painting: (1) the absence of the sloping muscle that is prominent on the ulnar side of the proximal aspect of the forearm in the painting, (2) an increased amount of muscle tissue in Dr. Tulp's forceps, (3) the reversed position of the index/small finger muscle bellies and the middle/ring finger muscle bellies of the flexor digitorum superficialis muscle in the painting compared with the anatomic dissection, and (4) the absence of the longitudinal cord-like white structure situated at the ulnar part of the small finger in the painting. What is the explanation for the observed anatomic differences between the dissection and the painting?

Could anatomic variations be a reason for the observed differences between the painting and the dissection? The sloping muscle (Fig. 2; area 1) has not been described as an anatomic variation in medical literature. This muscular structure could have been created by Dr. Tulp, transferring the flexor carpi radialis muscle to lift the flexor digitorum superficialis muscle, or it can be considered an artistic error in the painting (Fig. 4). A review of the medical literature showed 5 general types of anomalies of the flexor digitorum superficialis muscle.[29] These variations include an associated muscle belly arising from the flexor digitorum superficialis tendon with reinsertion into the same tendon, attachment of the flexor digitorum superficialis tendon to the flexor retinaculum, digastric muscles, distal extension of the muscle bellies, and anomalies of the superficial muscle layer in the distal forearm.[29] However, the anomalies of the superficial muscle layer in the distal forearm are less common and usually incompletely described.[29] It cannot be excluded that the observed differences of the flexor digitorum superficialis muscle between the painting and the dissection are based on anatomic variations. It should be mentioned that the 28-year-old executed criminal in Rembrandt's painting has a more muscular appearance compared with our 41-year-old dissected corpse, which may explain the difference in the amount of muscle tissue.

Normally the ulnar nerve passes through Guyon's canal and divides into 2 branches at the carpus: a superficial sensory and a deep motor branch (Fig. 5A). Guyon's canal is situated radial to the pisiform. The superficial sensory branch divides into 2 components: an ulnar branch that forms the ulnar proper palmar digital nerve of the small finger and a radial branch that forms the common palmar digital nerve of the fourth intermetacarpal space.[30] Several anatomic variations have been described of the sensory and motor branches of the ulnar nerve after passing Guyon's canal.[30–32] At first sight the longitudinal cord-like white structure in the painting does not seem to be part of the ulnar nerve because it is located outside Guyon's canal and is situated ulnar to the pisiform. Several case reports refer to an anatomic variation of the ulnar nerve in which the ulnar proper palmar digital nerve to the small finger arises from the dorsal branch of the ulnar nerve instead of the superficial sensory branch (Fig. 5B).[33–36] The dorsal branch of the ulnar nerve normally is not visible on the volar aspect of the wrist. In these cases it gives off a branch that continues as the ulnar proper palmar digital nerve to the small finger that emerges at the dorsomedial border of the flexor carpi ulnaris muscle and the ulnar aspect of the pisiform. This anatomic variation of the ulnar nerve is in accordance with the longitudinal cord-like white structure in the painting (Fig. 5C); however, the longitudinal cord-like white structure in the painting is coursing slightly toward Camper's chiasma. The longitudinal cord-like white structure in the painting has been identified as the dorsal branch of the ulnar nerve in

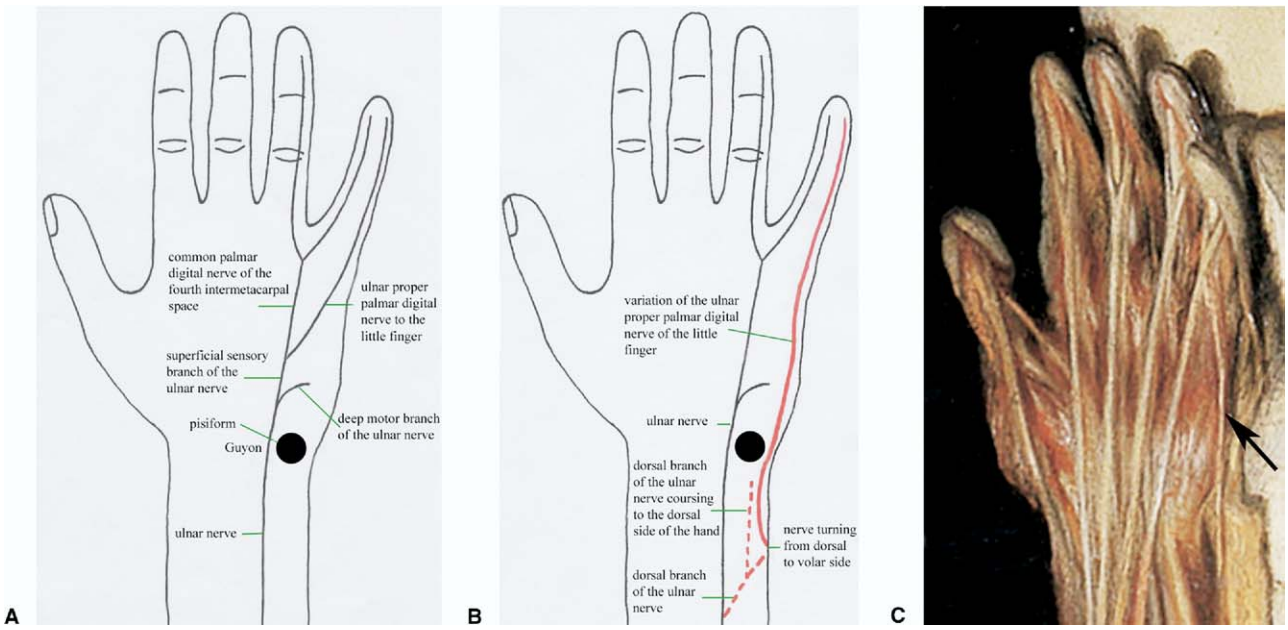

Figure 5. (A) Standard course of the ulnar nerve. (B) Anatomic variation of the ulnar nerve. (C) Dissected hand in the painting in which the longitudinal cord-like white structure (arrow) situated at the ulnar side of the hand could be identified as an anatomic variation of the ulnar nerve.

previous literature.[18,19] Without any reference to an anatomic variation the standard course of the dorsal branch of the ulnar nerve could not explain the longitudinal cord-like white structure in the painting. Rembrandt could have painted an anatomic variation of the ulnar nerve, in which case the nerve coursing slightly toward Camper's chiasma is an artistic error in the painting (Fig. 4), or the entire longitudinal cord-like white structure in the painting can be considered an artistic error.

Could alterations or additions that have been made to the painting explain the anatomic difference between the painting and the dissected forearm? Restoration of the painting from 1996 to 1998 offered an opportunity to analyze Rembrandt's painting technique.[1] Rembrandt was an artist whose compositions gradually originated on the canvas and during this process several adjustments were made.[1] All figures were part of Rembrandt's final composition.[1] Frans van Loenen (seated most superior) was portrayed initially wearing a black hat.[1,2] The right hand from the corpse is painted on what initially was a stump.[1,10] Aris 't Kint could have been punished by amputation of his right hand before execution.[1,10] Rembrandt initially painted an anatomic illustration of an arm on the paper held by one of the surgeon observers. Rembrandt's painting of an anatomic illustration of an arm on the piece of paper was covered by a second layer of paint, probably while the painting was being restored in the 18th century, consisting of a list of names of the surgeon observers. The uppermost layer of paint with a list of names of the surgeon observers has for the greater part been removed during the restoration from 1996 to 1998 so that the original layer of paint with the anatomic illustration of an arm was made visible on the paper held by one of the surgeon observers.[1] There is no doubt about the authenticity of the anatomic appearance of the dissected left forearm: its appearance is original as depicted by Rembrandt in 1632.[1] Research of the painting, however, showed that Rembrandt had replaced the dissected forearm from a higher to a lower position in the painting.[1] The adjustments to the painting that were made by Rembrandt indicate that the painting went through the working process of the painter. It cannot be excluded that adjustments to the painting contributed to the anatomic differences between the painting and the dissected forearm.

Is it possible to recall the circumstances in which Rembrandt made the painting? Did Rembrandt make drawings during Dr. Tulp's public anatomic lesson and use them to create the painting later in his workshop? There are no records about Rembrandt being an eyewitness to the dissection[1] and to our knowledge no drawings that could have been made by Rembrandt during the public anatomic lesson are available. Did he use a real limb with or without additional anatomic illustrations to finish the painting? Records about the corpse having been brought to his workshop are not available.[1] The details and realistic colorful appearance of the original painting

suggests that Rembrandt used a real limb and the members of the Guild posed for Rembrandt to complete the painting.[1,2,18,19] Attempts at identifying the book on the standard (Fig. 1; right corner) and the anatomic illustration (Fig. 1; held by one of the members of the Guild) have been unsuccessful.[1] According to previous literature the anatomic works of Vesalius (*De Humani Corporis Fabrica Libri Septem* in 1543) and Adriaen van den Spieghel (*De Humani Corporis Fabrica Libri Decem* in 1627) are not considered Rembrandt's direct model in creating the dissected arm as seen in the painting[1,2,9,17–19,25]; however, it is not possible to construct the exact circumstances in which Rembrandt created the painting.

A portrait painter's success depended heavily on his skills to produce an acceptable likeness of his sitters following existing visual conventions,[37] but did Rembrandt record an exact representation of the public anatomic lesson held on January 31, 1632? None of the anatomy paintings of the Amsterdam Guild of Surgeons display an exact representation of an anatomic lesson.[1] They are all group portraits and commemorate the tenure of a Praelector Anatomiae or membership of the Amsterdam Guild of Surgeons.[1] Rembrandt seems to have painted a realistic reproduction of an anatomy lesson.[1] *The Anatomy Lesson of Dr. Nicolaes Tulp* records a group portrait in the form of an anatomy lesson but not an exact representation of Tulp's anatomic dissection held on January 31, 1632. In group portraits from 1684 onward it is even more obvious that the depicted anatomy is not the primary interest but rather the individuals themselves are The dissecting table with a dissected body of an executed criminal was replaced gradually by a desk with, for example, a skull or a single dissected organ. The contribution of anatomy in the collection of paintings of the Amsterdam Guild of Surgeons decreased over time and the figures themselves increasingly dominate the compositions.

A public anatomic lesson in the 17th century usually started with dissecting the perishable organs of the abdomen and thorax; the extremities were the last to be dissected.[1–3] In Rembrandt's painting, however, the forearm already has been dissected whereas the rest of the body still is intact. This is another reason to believe that Rembrandt's painting does not record the real situation of Dr. Tulp's dissection but rather represents a symbolic interpretation.[1–3] Public anatomic lessons were often preceded by a moralistic oration in which the audience was encouraged to recognize their own mortality.[1–3] The science of anatomy was considered a path toward the knowledge of God.[1–3] Even moralizing inscriptions inside the anatomic theater reminded visitors of the transitory of existence.[1]

Andreas Vesalius (1514–1564), an anatomist originally from Brussels, is believed to have influenced Tulp's choice of pose through the woodcut front piece of his book *De Humani Corporis Fabrica Libri Septum* with a portrait of himself showing the flexor muscles of the forearm.[1–3] Vesalius had accomplished a revolution in the knowledge of human anatomy by studying the functionality of anatomic structures in a practical way and refuting the theoretic descriptions of the ancient anatomists.[1,3,10] In his own book Tulp wrote that "anatomy is the very eye of medicine" and that "it brought forth the truth as it were out of the shadow into the light."[2] Vesalius considered the human hand a physical counterpart of the human psyche, an instrument for using further instruments and a representation of God's wisdom.[2] Tulp was familiar with Vesalius's theories from his teacher in Leyden (Pieter Pauw), who had been a student of Vesalius.[1] One century later Dr. Tulp might have chosen to be depicted with a dissected forearm to be considered the Vesalius of his time and confirmed a new era in establishing the connection between practical anatomy and functionality.

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