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Adrianus Spigelius' (1578 – 1625) Ocular Anatomy

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The aim was to study Adriaan van den Spiegel's ideas on ocular anatomy. He is better known by his Latinized name as Adrianus Spigelius (1578 – 1625). He was a Flemish physician and anatomist who lived and worked in Padua, where in 1605 he was elected to be Professor of Anatomy and Surgery. Chapter IX of book ten of Spigelius' work on human anatomy, entitled *De humani corporis fabrica libri X tabulis aere icisis exornati* (1627) was devoted to an anatomical description of the eye. Corresponding to contemporary ideas of the production of knowledge Spigelius endeavoured to enhance Andreas Vesalius' (1514–1564) anatomy, he did not repeat his predecessor's theories of ocular anatomy. He conceptualised that the eye has six muscles, five tunics and three humors, while he gave a brief description of ocular physiology combining anatomy and the functional role of the anatomic ocular parts. **Conclusion.** He managed to correct Vesalius' errors and to present ocular anatomy with original notes, which so far, have been ignored and are highlighted now.

Introduction

Adriaan van den Spiegel, or as he is better known by his Latinized name, Adrianus Spigelius (1578 – 1625), was a Flemish physician and anatomist who lived and worked in Padua. He was born in Brussels and studied medicine at the Universities of Leuven and Padua. In Padua he was a student of Hieronymus Fabricius, or Girolamo Fabrizio, known also by his Latinized name as Fabricus ab Aquapendente (1537–1619). After his studies he returned for a while to his own country but from 1605, when he was appointed Professor of Anatomy and Surgery at the University of Padua, he settled in that city until his death (1). He was considered one of the best physicians of the time. Two years after his death, in 1627, his most important work on anatomy was published, entitled: *De humani corporis fabrica libri X tabulis aere icisis exornati* (2). The title of this book was influenced by the work (*De humani corporis fabrica*, 1543) by his fellow-townsman Andreas Vesalius (1514–1564) who had also studied at Padua (3). The aponeurosis of the transversus abdominis (Spigelian fascia), the linea semilunaris (Spigelian line) and the caudate lobe of the liver (Spigel's lobe) bear his name. A hernia of the Spigelian fascia is also called "Spigelian hernia". In his work, *De semitertiana libri quatuor* (1624) we find the first accurate description of malaria. In his anatomical works we can also find detailed descriptions of blood vessels and of the nervous system. Adrianus Spigelius also studied botany, giving his name to the genus Spigelia, while the rhizome and roots of *Spigelia*

marilandica were used as a remedy against intestinal parasites. Apart from his other pioneering work in medicine, his contribution to ocular anatomy has a distinct place in the history of medicine and anatomy (4).

The aim of our paper is to highlight Adrianus Spigelius' contribution to the history of ocular anatomy, because it is very important and mainly unknown.

Adrianus Spigelius as an Ocular Anatomist

Chapter IX of Book Ten of Spigelius' work on human anatomy, entitled *De humani corporis fabrica libri X tabulis aere icisis exornati,* is devoted to an anatomical description of the eye. Spigelius described the ocular muscles, ocular tunics, ocular humors and ocular nerve (2).

According to him the eye has six muscles. Four of them arise from the bottom of the orbit, leading to its middle, and accompany the ocular nerve. They are placed above, below and to the right and left of the orbit, to move the eyeball in these directions. The fifth muscle, which is considered to be the longest and slenderest, arises in the same place as the right muscle mentioned earlier, but when it reaches the Glandula Lachrymalis in the inner corner of the orbit, it ends in a slender tendon which is suspended in the insertions of the muscle that moves the eyeball upwards, and the other which moves it to the inner corner. The sixth one arises from a small hole in the lower part of the orbit, from which the nerve of the third conjunction also stems and ascends transversely to the outward corner in order to turn the eyeball in that direction. Spigelius underlined that the tendon of this muscle, which helps it to pass through the small hole, and the tendon of the outward muscle of the eyeball are often considered mistakenly as one due to their slenderness (2).

Regarding the tunics of the eyeball, Spigelius recognized five of them. According to him the first one found first during a dissection derives from the epicranium and extends over the white of the eye up to the iris. He believed that its role was to bind and give more strength to the orbit of the eyeball. He reported its three known names: Conjunctiva, Adnata and Epipephycos.

As the second tunic Spigelius listed the Cornea, pointing out that it had been given its name due to its resemblance to a horn. He noticed that it extended from the end of the conjunctiva, covering the iris, but also that it is clear and perspicuous in its forepart as far as the iris, but obscure in the hind part due to diverse polishing. On the forepart it is dense because it may preserve the crystalline humor, but transparent in order not to block the crystalline humor. He thought that it derived from the Dura Mater (Crassa Meninx).

The third tunic is the Uvea or Grapy coat, because it is similar in shape to a grape. Its origin was thought to be the Pia mater and that it encompassed all the eye except the pupil. It is nourished by the veins and arteries of the Cornea. At the level of the crystalline humor, it descended deep into the eye and then curved in order to protect it from the Albugineous humor. He also had the idea that the different colors of the uvea, such as black, brown, green and blue, had a special role in allowing people to see all the different colors of light.

The forth tunic, according to the physician, is the Amphiblistroides or Retiformis because it derives from the optic nerve, extends into the back pole of the eye and has a net-like shape, due to the net-like complex of the veins and arteries. It was described as a soft tunic in contrast to the crystalline humor and the cornea, because it has a special role, to form the image of the objects seen after the visual spirit has passed through the other anatomical structures. Therefore,

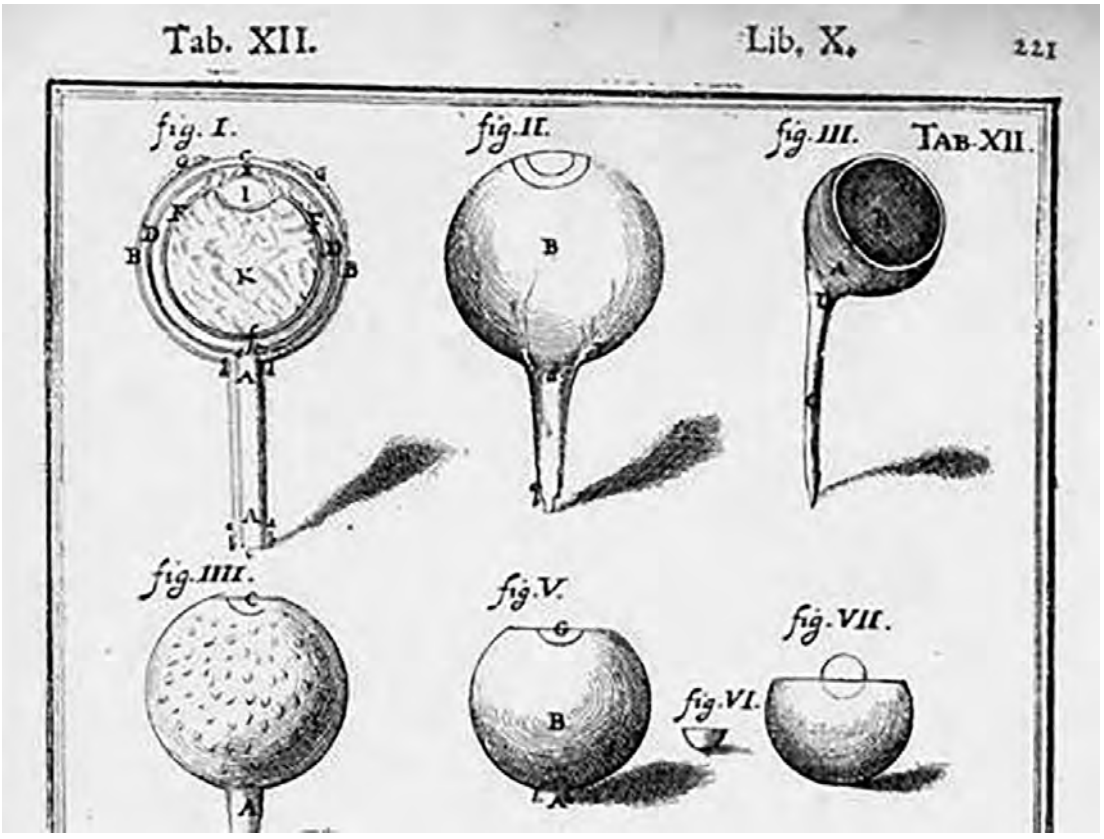

Figure 1. Giulio Cesare Casseri's design on ocular anatomy. Spiegel A. van den, Valasius F. De humani corporis fabrica libri decem. Venetiis, Deuchinus, Evangelista, 1627.

according to Spigelius, it had the most crucial role in vision and was considered to be a delicate structure.

The physician considered the fifth and last tunic to be the Arachnoides coat. Its name derives from its consistency, like a spider net. It is white, clear and the thinnest coat. It encompasses the crystalline humor on the fore side in order to protect it and to act as the vision structure in case the other humors are injured. It was believed that it derived from the excrementitiously humidity of the crystalline humor, which was hardened in order to form a coat by the coldness of the adjacent parts (2).

Spigelius did not forget to describe the three humors in the eyeball. The first was called the Aqueus or water humor, due to its resemblance to water. It took its place between the transparent part of the cornea and the portion of the crystalline humor lying towards the apple of the eye. According to the physician, this humor had a dual role. On one hand, it could be used as a barrier in order to distinguish the cornea, and on the other to protect the crystalline humor to prevent it from losing its moisture due to the light.

The second humor is the crystalline one already mentioned. It received its name due to its crystalline characteristics in brightness and color. Its shape, although round, is flattened on the foreside but not so much as from behind. The construction of this humor was believed, by the physician, to serve a practical purpose. The form of this anatomical part allows the image to be seen in its real shape, like in a mirror, and not to be transformed as it would be seen through a crystalline sphere. The back side of this humor, which is also considered to be the middle humor, was

believed to swim in the third humor from which it is nourished by the transposition of matter, but mainly of the net of the fifth coat which encompasses it.

The third humor was the so-called Vitreus, glassy or Hyaloides of Albugineous humor, which received its name due to its resemblance to molten glass or to egg albumen. It is located behind the crystalline humor, filling the empty space up to the fifth coat, and is therefore the largest humor of the eye in terms of quantity and is nourished by the vessel net of the fifth coat. Its use, according to Spigelius, was to protect the brain from the violence of the light and colors (2).

Discussion

Adrianus Spigelius wrote his treatise on the anatomy of the human body without any illustrations. This work was published two years after his death by Daniel Bucretius (?-1631) as was his wish expressed in his will. In order to fill this book with illustrations, Bucretius used 77 of 86 anatomical sketches designed by Giulio Cesare Casseri (1552-1616), the servant of Fabricus ab Aquapendente and which were presented for the first time in Casseri's treatise *Tabulae anatomicae* (1627) (5). These sketches were drawn by the painter Odoardo Fialetti (1573-1638?) and engraved by the painter Francesco Valesio (1560? - 1643?) (6).

Although the concept of Spigelius' anatomical treatise was influenced by Vesalius' anatomical treatise, mentioned above, as we may infer from the similar title, the analogous division of the chapters and the similar method of using the Greek and Latin terms of the anatomical parts (7), this was nevertheless an original work in anatomy which had a pioneering character, not only in the different format of the anatomical sketches, which were more detailed and mainly focused on anatomy and medicine, but also in the context of the anatomical descriptions.

This originality is also found in the anatomical description of the eyeball.

Namely:

- Spigelius went further than Vesalius, not mentioning the extra retractorius musclulus, while he located the crystal lens in the foreside and not in the middle of the eye ball as Vesalius did (8).
- He located the lens even more to the fore, as Giovanni Battista Della Porta (1535?-1615) did (9).
- He avoided describing the eye ball as a sphere, pointing to its more, but not completely, oval shape, which was an original note. He did not avoid considering the eyeball as a projection of the cerebrum and to locate the ocular nerve almost in the middle of the back pole of the eyeball (10).
- The descriptions of the veins and the arteries were very detailed, which allows us to remember similar detail, especially in the drawings found in the work of Georg Bartisch (1535–1607) (11).
- He tried to correlate ocular anatomy with the physiology of vision.

The significance of the progress in ocular anatomy as it was presented by Spigelius should be considered to be the fact that he rethought ocular anatomy, giving an opportunity to later anatomists and ocular surgeons to be more careful in their surgical or anatomical approach to the eyeball.

Conclusion

In conclusion we may say that Spigelius' ocular anatomy is characterized by its originality. Although Spigelius tried to imitate Vesalius in the form of his anatomical treatise, he did not repeat the theories of ocular anatomy presented by his predecessor. He managed to correct Vesalius' errors and to present ocular anatomy with original notes. However, we should bear in mind that even Spigelius did not succeed in giving an accu-

rate anatomical description of the eye ball, which was achieved much later by Johann Gottfried Zinn (1727-1759) (12). It is impressive that Spigelius tried to explain the characteristics of the humors and tunics of the eye, connecting them with the theories of vision and the physiology of the eyeball, albeit in a primitive way, very far from modern medicine and physiology (13). Nevertheless, this effort demonstrates the originality of his anatomical work about the eyeball.

What Is Already Known on this Topic

The history of ocular anatomy is very interesting because anatomists have many difficulties in understanding ocular anatomy without making mistakes. Andrianus Spigelius had a special role in the understanding of ocular anatomy but very little is known about it.

What this Study Adds

Our manuscript presents for the first time a detailed analysis of how Adrianus Spigelius conceived ocular anatomy and the differences to earlier treaties on ocular anatomy. Adrianus Spigelius' contribution to the theme is also highlighted.

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Conflict of Interest: The authors declare that they have no conflict of interest.

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