A REVIEW OF ACHARYA SUSHRUTA’S APPROACH IN DISSECTION FOR THE STUDY OF NETRA SHAREERAM

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ABSTRACT

Recent literature suggests that the dissected cadaver remains the most powerful means of delivering fundamental regional, relational and topographical anatomical knowledge to medical students, which is indispensable to ensure safe and efficient clinical practice. Acharya Sushruta is best known for his surgical wisdom, practices and tools. He described a systematic method for the dissection of the human cadaver. Netra is one of the most briefly described anatomical structure by Sushruta. Anatomically, eye is divided into five Mandalas, six Sandhis and six Patalas. Selection of appropriate cadaver was very necessary for the detailed study of human anatomy; hence Acharya Sushruta had described various conditions for the selection and preservation of the cadaver. In this paper the potentially possible scientific reason for such selection criteria, as well as an attempt to understand the anatomy of eye in prospect to the ancient text by our acharyas is made. In addition, an approach is made to study importance of eyes with respect to knowledge about Dirghayu, Madhyamayu & Heenayu of a person, to know about the Arishta Suchaka Lakshana in patient, to know the Sadhyaasadhyata of a Vyadhi, & to decide the Sara of a person.
Keywords: Shavavicchedana, Netra Shareer, Mandala, Patala, Sandhi, Dirghayu, Madhyamayu, Heenayu, ArishtasuchakaLakshana, SadhyaAsadhyata, Sara

INTRODUCTION

Human cadaveric dissection has been used as the core teaching tool in anatomy for centuries. The introduction of systemic human cadaveric dissection is a remarkable moment in the history of science. Two sets of texts form the foundation of Ayurvedic medicine, the SushrutaSamhita and the CharakaSamhita. The SushrutaSamhita gives knowledge about important surgical and anatomical information of human anatomy. AcharyaSushruta is best known for his surgical wisdom, practices and tools. He described a systematic method for the dissection of the human cadaver. In 5th chapter of Sharirsthana in Sushrutasamhita, importance of Shavavicchedana(dissection), method of selection of dead body, method of preservation of dead body is described.2

Importance of Shavavicchedan- Susruta Samhita mentions the role of a student in the dissection: “A pupil, otherwise well-read, but uninitiated, in the practice (of medicine or surgery) is not competent to take in hand the medical and surgical treatment of disease.” Therefore, one who intends to acquire definite knowledge of surgery should study the anatomy practically by dissecting the dead body properly. Whatever is practically seen and whatever is known from scriptures both combined develops the knowledge further. According to Acharya Charak, knowledge of Sukshma and Sthulashareer is very necessary for Shareer-Rachna. Even so, recent literature suggests that the dissected cadaver remains the most powerful means of delivering fundamental regional, relational and topographical anatomical knowledge to medical students, which is indispensable to ensure safe and efficient clinical practice.4 Evidence suggests that learning anatomy by active exploration through cadaveric dissection actually contributes to improvement of anatomic knowledge. There is also compelling evidence suggesting that the knowledge of human anatomy was revealed by both inspection of the surface of the human body and through human dissection, as he believed that students aspiring to be surgeons should acquire a good knowledge of the structure of the human body.

Selection of Cadaver-A cadaver should be selected which has all the parts of the body present, of a person who had not died due to poisoning, but not suffered from a chronic disease, had not attained a 100 years of age and from which the fecal contents of the intestines have been removed.6 The probable reason of such selection criteria must be because all the above condition can hinder with the observations made from the study. It is important to have all the parts of body to cover each organ for the study. Various poisons cause ocular effect which can alter the anatomical points of the eye and affect the study. For example, Carbon monoxide can cause retinal haemorrhage, venous tortourity, engorgement or papilloedema.7 Pesticide exposure has been associated with retinopathy in agricultural workers & abnormal ocular movements. Sakù disease, an optic autonomic peripheral neuropathy has been described in people living in area where organophosphates are used. There may be drug induced ocular toxicity such as systemic cytarabine can cause keratitis, corneal opacity, corneal oedema.8 Opium, Carbolic acid & Chloral hydrate causes pupil constriction. Dhatura, Belladona & Chloroform dilates the pupil. In kalpashana of Sushruta Samhita, he has described ocular features in certain poisoning, such as vapours coming from poisonous food causes Vibhranta Netrata, Amashayagata & Pakwashayagata Visha causes Indriya Vikrata, Savishaanjana when applied can cause Ashru, Upadeha, Daha, Drishtivibhrama& even Andhyatva. Poisoning from Vatsanabhid & Kadarma causes Peetanetrata, that from Pundarika can cause Rakta Netrata. Just like this, many chronic systemic or ocular diseases can enhance ocular damages. Retinopathy or maculopathy caused by Hypertension, collagen vascular disorders, Giant cell arteritis causes ocular damage. Sole Diabetesc can cause cataract, background retinopathy, neovascularisation, ocular motor nerve palsy, papillary

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4164
anomalies & refractive errors. The effect of systemic disease and toxin can also be understood by this that according to Acharya Dalhana, Uttarantra which contain major part of Shalakyanattra, is started after kalpasthana that deals with toxicology. So, the poison or infected wound can produce complication anywhere in the body. He may be of the view that most of the disease of eye, ear etc., are the complication of systemic disease and toxins. Acharya dalhan has also said “Sarveendriyanaam madhye nayanasya pradhantvata” i.e. eye is present in between all Indriya and is prime so foremost anatomy of eye has been described in detailed. Age of the cadaver should not be more than 100 years as degeneration of organ starts at elderly age like changes in skin, fall down of teeth, bones become weak, muscles get shrink, and ligaments get flaccid which causes problem in studying the parts. Intestine should be emptied- because many bacteria are present in there that causes early decomposition, also after cleaning the intestine it will be prepared as a specimen for the study.

Preservation of cadaver- Such a cadaver, whose all parts are wrapped by any one of “Munja” (bush or grass), Valkal, “Kusha” and Shana and kept inside a cage, should be put in a slowly flowing river and allowed to decompose in an unlighted area for seven days. Stagnant water is home for many microorganisms which can damage the body, that’s why it should be kept in slowly flowing river and the water keeps the skin moist and free from odour. To protect from other animals & prevent the body from drowning, it was kept in a cage. Wrapping the body with Munja, Valkala, Kusha and Shana protects the body from animals. Valkala has properties like Antiseptic, Anti-inflammatory, Antioxidant, Antibacterial, Antimicrobial, Wound purifying & Healing and Astringent, also in Ayurveda Panchavalakala is said to has Shothahara & Vranopaka property. Kusha has antibacterial, astringent, antiseptic & toning property. Shana is a source of natural fibre, Astringent, Antimicrobial activity. All this method kept the cadaver safe from harm, destruction or decomposition.

**Netra Shareer Rachna in Sushruta Samhita**-

The only authentic source of Shalakya Tantra knowledge is Uttarantra of Sushruta Samhita which has been written as per teachings of Acharya Nimi. Acharya Sushruta has given prime importance to Netra and described in detailed about the various anatomical content in term of their embryology, situation, size, shape & relation.

**Position-** Head is the supreme part of the human body, when compared to all other parts. It is the site of life for living beings. All the senses and their organs are situated in and supported by the head.

**Shape -** In SushrutaSamhita Uttarantra, Acharya has described Netra as Suvrittam, Gostanakaram and Nayana Budbudam, which denotes the shape and consistency of the Netra.

a. **Suvrittam:** By the word Suvrittam means, that eye is spherical from all sides.

b. **Gostanakaram:** eye is shaped like that teat of the cow i.e. oblong shaped or oval shaped. Eyeball seen along with extra-ocular muscles and optic nerve is very much similar to Cow’s teat.

c. **Nayana Budbudam:** It is round in shape and soft in consistency and glistening in character, this term is suggestive of external appearance of the eye in the eye orbit

**Dimensions of netra**— The measurements of the eyeball were described by Sushruta in terms of Anguli, like any other organ but, Anguli in context to measurement of Netra is equal to Swangushthodara- one’s own thumb in the words of Sushruta, which has been supported and clearly written by the commentator Dalhana. While describing the dimensions of eye, Sushruta had given two dimensions – 2 Angulas Bahulya and 2 ½ Angulas Sarvatah. According to Dalhana and some scholars, the word Bahulya means antero-posterior diameter or thickness of the eyeball and it is 2 Angulas. As per their view, the word Sarvatah can be considered as the side-to-side measurement i.e. circumference of the eyeball; and it is 2 ½ Angulas. But the exact measurement of 2 ½ Angulas is better applicable to the side to side distance of the eye, i.e. the distance from inner canthus to outer canthus. There is some different interpretation for the word,
Dvyangulam Sardham. According to Dalhana, the word DvyangulamSardhama means ArdhaTriteeyangula. This was commented by some scholars as 3 ½ Angula, and they apply it as the circumference of the eyeball.

Anatomical parts of the netra: The anatomical parts of the eye were described by Sushruta as five Mandalas, six Sandhis and six Patalas.

Table 1: Mandalas- The consecutive circular layers of the eyes are termed as Mandalas.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name</th>
<th>Probable structure of eye according to modern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pakshma Mandala</td>
<td>Eye lashes when eyes are open</td>
</tr>
<tr>
<td>2</td>
<td>Vartma Mandala</td>
<td>Eye lids when eyes are closed</td>
</tr>
<tr>
<td>3</td>
<td>Shukla Mandala</td>
<td>Sclera covered with conjunctiva</td>
</tr>
<tr>
<td>4</td>
<td>Krishna Mandala</td>
<td>Cornea and Iris</td>
</tr>
<tr>
<td>5</td>
<td>Drishti Mandala</td>
<td>Central part of cornea/Lens cortex/Pupil/visual axis</td>
</tr>
</tbody>
</table>

Table 2: Sandhis- Sandhis are the Junctional Areas’ between two Mandalas

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of the Sandhi</th>
<th>Probable structure of eye according to modern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pakshma – Vartmagata</td>
<td>Eye lid margin</td>
</tr>
<tr>
<td>2</td>
<td>Vartma – Shukla gata</td>
<td>Fornices</td>
</tr>
<tr>
<td>3</td>
<td>Shukla – Krishna gata</td>
<td>Limbus/ Corneo-Scleral junction</td>
</tr>
<tr>
<td>4</td>
<td>Krishna - Drishti gata</td>
<td>Pupillary margin</td>
</tr>
<tr>
<td>5</td>
<td>Kaneenaka Sandhi</td>
<td>Medial canthus</td>
</tr>
<tr>
<td>6</td>
<td>Apanga Sandhi</td>
<td>Lateral canthus</td>
</tr>
</tbody>
</table>

Table 3: Patalas- Which means a layer, veil, covering chest, membrane especially of the eyes, a film over the eyes. There are 6 Patalas in the eyeball – 2 Vartma Patalas (Upper and Lower) and 4 Akshi Patalas (Layers in the eyeball)

<table>
<thead>
<tr>
<th>Name</th>
<th>Anatomical Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahya1stPatala</td>
<td>Sclera &amp; Cornea</td>
</tr>
<tr>
<td>2ndPatala</td>
<td>Uveal Tract</td>
</tr>
<tr>
<td>3rdPatala</td>
<td>Lens Cortex with peripheral Retina</td>
</tr>
<tr>
<td>Last4thPatala</td>
<td>Lens Nucleus with Central Retina</td>
</tr>
</tbody>
</table>

Other references of eye anatomy in Sushruta- Sushruta has used Vartma Mandala and Vartma-Patala to suggest eyelids. Vartma Mandala refers to both eyelids when closed whereas VartmaPatala refers to upper & lower eyelid. Vartma Mandal Tarunasthi in Sushruta suggest the tarsal plate where as Vartma Santhi suggests as inner and another canthus. The term ‘Netrakosha’ is used by Sushruta in Tarpan Kriya chapter. While describing sites of oblique incision Sushruta used the term ‘AkshiPuta’ where as Dalhana refers as Akshivartma. Charaka used the term as ‘Akshivartma’ in Pratyanga Shareer. The term Vartma Kosha is coined in Sushruta Uttartantra to describe inflammatory conditions of eyelid. This implies palpebral part of conjunctiva. Vartma-Shukla Sandhi refers to the junctions of palpebral and bulbar conjunctiva. Shuklataraka, Tejojalashrira Bahya Patala - These terms refer to cornea as it is described during surgical procedure of Linganasha (cataract). The description of Savrana Shukla, Avrana Shukla and Akshki-Pakatyaya refers to corneal injuries. Hence ‘Shukla taraka’ term was used to denote cornea. Nimeshini and Unmeshini Sira- Sushruta and Dalhana refer to a disease Vartma Nimesha in which a symptom of winking of eyes is evident. Both explain that this phenomenon occurs due to defect in Un-
This disease is also described in modern ophthalmology as blepharospasm. It is said to be caused by spasm of muscles due to stimulation of ocular branch of facial nerve and ocular motor nerve. As facial nerve (ocular branch) regulates closing of eyelids, we can correlate it with Nimeshini Sira, and ocular motor nerve regulates opening of eyelid we can correlate with Unmeshini Sira.

**DISCUSSION**

While talking about Drishti Acharya Sushruta has described the Drishti to be the size of Masurdala, prasada of Pancha-Mahabhootas, gleaming like a glow worm or covered by the external patala of the eye and appearing like a hole having a natural tolerance to cold. Sushruta has given the measurement of Drishti as 1/7th of Krishna Mandala in Uttarantara. But in Sutrasthana, it is described as 1/9th of Taraka. Here the meaning of Taraka was given as Krishna Mandal. So different measurements for the same structure given by the same author points that Drishti is a constricting and dilating structure and this also points to the pupil. So, 1/7th of Krishna Mandala is probably the measurement when the iris is dilated, while 1/9th of Krishna Mandal is the measurement when the iris is constricted. Going through the description, we can see that Sushruta has dealt with Patala in brief but without mentioning their exact anatomical position in the eye. Moreover, the concept of Patala in context to Sawranashukla, can be taken as three layers of cornea, i.e. Epithelium, Stroma & Descemet membrane including endothelium. Whereas, in context to Nayanabhigata, Patalas can be taken as the three tunics of the eyeball. While describing Timira, Kaanch, Nilika, & Linganasha Sushruta & Vagbhata have classified its stages in relation to its involving different Patalas of Drishti Mandala. The outer fibrous coat, i.e. cornea & sclera which gives shape, size & protection to the eyeball is the first Patala. Axial length & curvature as causes of refractive errors are due to the anomalies in this coat of eyeball.

Second Patala can be considered as the uveal tract. Uveal tract has most sensitive tissues & develop an inflammatory response following innumerable exogenous causes resulting into fall of vision. This causes vitreous opacity resulting into floaters in front of eyes. All these are the clinical feature of second Patala pathology described by Sushruta. Clinical feature of third Patala are very much similar to the corticular part of opacity of the lens. Fourth Patala is inner most & constituted by Asthi, the hard tissue. With advancement of cataract nearly complete loss of vision is there, where in pupillary colour change to dense grey, which are similar to feature of fourth Patalagata Timira. After reading the description on eye anatomy by Sushruta it is clear that he had first observed the structure from outside and wrote the details what he saw from observing. While writing about Mandalas he said “Anupurvantu Temadhyya Chatvaroantyuttam”, i.e. from going outside to inside Pakshma is followed by Varta, Vartma is followed by Shukla, Shukla is followed by Krishna & Krishna is followed by Drishti Mandala. While coming from inside to outside this sequence is reversed it goes from medial to more lateral. This was observed before dissecting the eyes. While discussing about the dimension of eye Acharya Sushruta has taken out eye along with the extraocular muscles and optic nerve that is why it resembled Gostanakaram. Alonge with anatomy of eye Sushruta has also told about its relations to structures like Sira, Kandara, Meda, Kalaka, Sleshma, that holds the eye in position. The Panchamahabhuta composition of eye given by Sushruta also proves that he has dissected the eye very keenly and came to know about the blood supply, muscular part & lacrimal apparatus associated with the eye. Also, while describing Purvalasa (Dacryocystisis) Acharya Sushruta and Dalhana both have described Ashru Marga and Netra Nadi. It means that lacrimal apparatus was known to both Acharyas. The term Ashru Vahini was also coined by Sushruta for the lacrimal apparatus. The different size of Drishti suggests that he has observed the eye in living human being. Also, the description of Drishti which include features like Masurdala, Khadyotvisphullingabham is also observed on a living body. The study of Patala can be said that it was done on a cadaver as the Patala are divided into Bahya and Abhyantar bhaga. In Ayurveda, the eyes were not only
important for its anatomical aspects but also to know about Dirghayu, Madhyamayu & Heenayu of a person, to know about the Arishtasuchakalakshana in patient, to know the Sadhyasaadyhata of a Vyadhi, & to decide the Sara of a person. Acharya Charak in Indriyasathana, gave many Arishtasuchakalakshanas related to eyes to predict the death of a person for example, a person whose eyelashes are stick together without any reason, lid oedema,& unable to close his eyes or if there is sudden loss of vision, all these are Arishtasuchaka lakshanas. A person who sees sky as a condensed matter and earth as nothing or a space & who sees a fire in various color will die in 7 days. While discussing about features of Asadhyavyadhi, Acharya Charak has mentioned feature like Indriyanasha i.e. loss of senses including vision In Sushruta Samhita Sutrasthana, a person with Dirghayu will have Shhira indriya, Madhyamayu will have few lines below the eyes, & Hinayu will have Vibhranta netrata. In above Chapter only, he has described Shareerpamana, the distance between two eyes is said to be 4 Angulas & distance between ear & outer canthus is 5 Angulas. While describing about various features of Sara, Shukra Sara Purusha will have Shwetanetra, Majjasara Purusha will have Mahanetra & Rakitasara Purusha will have Snigdha Netra.

CONCLUSION
In this paper the potentially possible scientific reason for such selection criteria, as well as an attempt to understand the anatomy of eye in prospect to the ancient text by our Acharyas is made. In addition, an approach is made to study importance of eyes with respect to acquaint in Dirghayu, Madhyamayu & Heenayu of a person, to know about the Arishtasuchakalakshana patient, to know the Sadhyasaadyhata of a Vyadhi, & to decide the Sara of a person. Further review of our Ayurvedic literature should be done to understand the Netra as a whole entity.

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