



ISSN: 0976-3376

Available Online at <http://www.journalajst.com>

ASIAN JOURNAL OF
SCIENCE AND TECHNOLOGY

Asian Journal of Science and Technology
Vol. 09, Issue, 04, pp.7859-7865, April, 2018

RESEARCH ARTICLE

A CRITICAL REVIEW STUDY ON ANATOMY OF EYE REVEAL IN ANCIENT INDIAN SCIENCE

***Dr. Lahange Sandeep Madhukar and Dr. Bhangare Archana Nivrutti**

¹Department of *Sharir Rachana* NIA, Jaipur 302002, India

²Department of *Kayachikitsa*, Mahtma Jyotiba Fule Ayurved College and Hospital, Chomu Jaipur, India

ARTICLE INFO

Article History:

Received 08th January, 2018

Received in revised form

19th February, 2018

Accepted 20th March, 2018

Published online 30th April, 2018

Key words:

Indriya, Netra, Drishti,
Ayurveda, Mandala, Patala.

ABSTRACT

Anatomical facts in ancient India were derived predominantly from animal sacrifice, chance observations of improperly buried human bodies, and examinations of patients made by doctors during treatment. The Vedic philosophies form the basis of the *Ayurvedic* tradition, which is considered to be one of the oldest known systems of medicine. Two sets of texts form the foundation of Ayurvedic medicine, the *Sushruta Samhita* and the *Charaka Samhita*. The *Sushruta Samhita* provided important surgical and anatomical information of the understanding of anatomy by Indians in the 6th century BCE. Here we review the anatomical knowledge known to this society. In ancient classics literature regarding Eye and Eye Hygiene has been available but scattered in different books. There is concrete need for comprehensive literary study of the anatomical and clinical aspects of Eye, from the available ancient literature.

Copyright © 2018, Dr. Lahange Sandeep Madhukar and Dr. Bhangare Archana Nivrutti. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Human anatomy is the science which deals the structure of the human body. Purusha considered as “Adhikarna” of Chikitsa in Ayurveda. The knowledge of the development stage of purusha, its dhatu formation & development of *Indriya* etc are necessary to know ayurveda. *Acharya Charak* has described that only those can become master of this science, who have knowledge of Anatomy & Physiology of this body as well as have knowledge about changes taking place throughout the life. According *Acharya Sushrut* Human body is the base of treatment, practical knowledge of it must be attained, without this knowledge a person cannot be considered as physician. The Eye “organ of Sight” is utmost important as for as outside & inside world of human body. Eye has special status among all the senses. Even a blind person can see with the help of “*Budhi Vaishashik Alochak Pitta*” but eyes can appreciate and perceive this beautiful world. *Vagbhata*, The great physician has rightly described the importance of eyes that without eyes the day & night are equal, so must be protected with utmost care. *Acharya Sushruta* is only one has emphasized about the scientific method of dissection of Human Cadaver and he is the solitary recognized Anatomist & Ophthalmologist of classical period of Ayurveda has very precisely talked of detailed anatomy of “*Netra Budbud*”(Eye). He has also described the *Praman*(anthropological measurement) or *Ayama* (length) & *Vistar*(width) of Eye and has claimed the similarity of Eye with “*Gostana*” (teat of cow). *Sushuta* has also talked about *Drishti pramana*.

The formation of eye has been described by *Sushruta* under *Garbha Bhav*(Fetus Formation Factor). According to *Sushruta* it has formed by “*Atamj Bhava*”¹. Eye has been described as *Bahirmukh Srotas*(external opening of the body) as well as *Gyanendrya* (sense organ). All five *Mahabhootas*(five elements) contribute to the formation of different parts of Eye ball. In appearance the eye ball is round & resembles the teat of the cow. Breadth of central part of individuals own thumbs the thickness (Vertical diameter) is two finger; its Horizontal diameter measures two & half fingers. The eyes consist of five *Mandala*, Six *Sandhis* & Six *Patalas*. The Shape & Situation of eye ball is maintained by *Siras* (Arteries, Veins & Nerves) *Kandara* (Tendons).

Embryological Development of Netra (Eye)²:

Acharya Sushruta has been explained origin of *Anga*, *Pratyanga* in 3rd month of fetal life although it is very minute, in 4th month it is clear and *garbha* perceives the *Indriya Artha*. So according *Acharya Sushruta* 4th month is the stage of *Dauhridaya*. In 7th month *Anga*, *Pratyanga*, *vibhaga* is almost complete³. The evolution of all sense organs occurs in the 3rd month of intrauterine life and completes at about 7th month.

- i. Sandeep *et al.* A critical review study on dissection techniques in ancient Indian Anatomy in context to its clinical significance, World Journal of Pharmaceutical and Medical Research, 2017,3(9), 371-375
- ii. Lahange *et al.* analytical outlook on concept of foetal anomalies in ayurveda with special reference to its etiopathogenesis, European Journal of Pharmaceutical and Medical Research, 2017,4(05), 289-295
- iii. Susruta: Susruta Samhita: with commentaries Nibandhasamgraha by Dalhana and Nyayacandrika by Gayadasa : Chaukhamba Orientalia, Varanasi : 5th Ed. (reprint 1992),

*Corresponding author: Dr. Lahange Sandeep Madhukar,
Department of Sharir Rachana NIA, Jaipur 302002, India.

There were differences in opinions among ancient Acharyas regarding the evolution of Netra.

- According to *Kashyapa* and *Bhela*, *Netra*(eye) is the first organ to develop in the fetus⁴.
- *Videha Janaka* opines that all *Indriyas* are the foremost organ to develop in the fetus as they are the *Adhithana* of *Buddhi*⁵.
- According to the opinion of *Shaunaka*, *Shir*(head) is the first organ to develop, as it is the seat of *Indriyas*⁶.
- *Atreya* and *Dhanvantari* conclude that all organs in the human body develop simultaneously⁷.

Even though eye is formed with combination of *Panchmahabhutas*, but *Tej Mahabhut* is main and major contributing *Mahabhut* among the five *Mahabhutas*.

Table 1. \$the Panchbhoutika concept of embryogenesis of Netra (Eye)

S.No.	Parts of Netra(Eye)	Contributing Mahabhoota
1.	Mamsabhaga (Muscular part)	Prithvi (Bhu)
2.	Shwetabhaga (White Part)	Jala
3.	Raktabhaga (Red Part)	Tejas/Agni
4.	Krishnabhaga (Black Part)	Vata
5.	Ashrumargas (Tear channels)	Akasha

Acharya Vagbhata has attributed the origin of *Indriya* to *Kaphavaha* and *Raktavaha srota*⁸.

Table No.2 shows the embryological development of Eye according to Acharya Vagbhata.

S.N.	Srotas	Eye Structure formed	Matruj-Pitrujadi Bhava
1.	Kapha Vaha	Sukla Mandala (Sclera and conjunctiva)	Pitruja
2.	Rakta Vaha	Krishna Mandal (cornea and Iris)	Matruja
3.	Kapha Rakta Vaha	Drishhti Mandala (Pupil, and their function)	Both

In Upanishada period, ocular anatomy was depicted in philosophical manner. In *Brihad Aranyaka Upanishada* different structures of eyeball were said to be evolved from different Gods as follows⁹ –

The colour of the Eye is also determined by the association of *Dosha* and *Dhatu* with *Tejomahabhoota* as follows-

Rakta Dhatu → in association with *Tej Mahabhoota* → *Raktakshi* (red eye)
Pitta Dhatu → in association with *Tej Mahabhoota* → *Pingakshi* (yellow eye)
Kapha Dhatu → in association with *Tej Mahabhoota* → *Shuklakshi* (white eye)

- Bhela, Bhela Samhita* edited by Shri Girija Dayal Shukla, Chaumkhambha Vidya Bhavan, 1st edition, 1969.
- Charaka, Charaka Samhita* with Ayurveda Dipika commentary by Chakrapanidatta edited by Vaidya Yadavaji Triakaji Acharya, Chukahmba Surbharati Prakashan Varanasi, Reprint 2016.
- ⁶ *Sushruta, Sushruta Samhita* of Maharshi Sushruta, Kaviraja Ambikadutta Shashtri, edited with Ayurveda-Tattva-Sandipika foreword by Dr. Pranajivana Manekchanda Mehta Chaukhambha Sanskrit Sansthan reprint edition, 2008.
- Charaka, Charaka Samhita* with Ayurveda Dipika commentary by Chakrapanidatta edited by Vaidya Yadavaji Triakaji Acharya, Chukahmba Surbharati Prakashan Varanasi, Reprint 2016.
- ⁸ Mitra J., Ashtanga Sangraha, Induvirachit 'Sashilekha' Vyakhya Samanvitha, Chaukhambha Sanskrit Series office, Varanasi, 1st ed – 2006.

Brahma Vidya khand, 108 *Upanishada* by edited by Pandit Shri Ram Sharma Acharya, Sanskriti Sansthan, Barielly, Reprint edition 4th, 1969. .viii

Table 3 Different structures of eyeball evolved from different deities

S.No.	God Name	Part of Netra	Part of eyeball
1.	Rudra	Reddish part of eye ball	Blood vessels
2.	Parajanya	Liquid portion	Aqueous & Vitreous humour
3.	Aditya	Kaninika, Ashrumarga	Lacrimal apparatus
4.	Agni	Blackish portion	Cornea, iris
5.	Indra	Whitish part	Conjunctiva, sclera
6.	Prithvi	Adho Vartma	Lower eyelid
7.	Akasha	Urdhva Vartma	Upper eyelid

Anatomy of Eye in Ayurvedic Samhita^{10,11,12}:

The detailed description of the anatomy of Eye is available only in *Sharirsthan* of *Sushruta Samhita*.

Location of Eye

Shirah (head) is the *Uttamanga* (supreme part) of the human body, when compared to all other parts. It is the seat of life for living beings. All the *Indriyas* (senses) are situated in and supported by the scalp. *Netra* is situated in the *Netra-Kosha*(Orbit), which from the shelters for two Eyes, but there is only one *Chakshurindriya*(sense of eye). These *Netrakotaras* (Orbital opening) are the two among the seven external openings of the *Shir*(head).

Shape of the Eye

Two terms are available in ayurvedic samhita regarding the organ eye viz. *Nayana* and *Netra* in *Uttara Tantra* 1st chapter, as narrated by *Acharya Sushruta*. Both are suggestive as shape. The shape of Eye has been described as *Suvrittam*, *Gostanakaram* and *Nayana Budbudam*, which denotes the shape and consistency of the *Netra* .

- **Suvrittam:** By the word *Suvrittam* means, that eye is spherical from all sides.
- **Gostanakaram:** By the word we mean, that eye is shaped like the teat of 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.
- **Nayana Budbudam:** It means like a bubble floating on the water i.e. round in shape and soft in consistency and glossy/glistening in character, this term suggestive of external appearance of the eye in the eye orbit.

Dimensions of Eye

The measurements of the eyeball were described by *Sushruta* in terms of *Anguli*(digit) like any other organ but, *Anguli* in context to measurement of Eye is equal to *Swangushodara* 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

- Ghanekar B.G., *Sushruta Samhita Sharirsthan*, Meharchand ,Lachmandas Publications, New Delhi-2006 .
- Susruta: *Susruta Samhita*: with commentaries Nibandhasamgraha by Dalhana and Nyayacandrika by Gayadasa : Chaukhamba Orientalia, Varanasi : 5th Ed. (reprint 1992),
- Vikash Bhatnaga*, a review study on the concepts of human anatomy in ayurveda, *International Journal Of Current Medical And Pharmaceutical Research*, Vol. 3, Issue, 04, pp.1598-1603, April, 2017 .xi

Angula Bahulya and $2\frac{1}{2}$ *Angula Sarvata*. It is difficult to trace the exact meaning of the words *Bahulya* and *Sarvata*. According to some scholars, the word *Bahulya* means antero-posterior diameter or depth of the eyeball and it is 2 *Angula*. As per their views, the word '*Sarvata*' can be considered as the side-to-side measurement or circumference of the eyeball; and it is $2\frac{1}{2}$ *Angula*. But the exact measurement of $2\frac{1}{2}$ *Angula* 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 '*Dvyangulam Sardham*' means '*Ardha Triteeyangula*'. This was commented by some scholars as $3\frac{1}{2}$ *Angula*, and they apply it as the circumference of the eyeball.

Anatomical Parts of the Eye

The anatomical parts of the eye were described by *Sushruta* as *Mandala*, *Sandhi* and *Patala*. There are 5 *Mandala*, 6 *Sandhi* and 6 *Patala* described by *Sushruta*. The same division was adopted by *Vagbhatta*, *Madhavakara* and *Bhavamishra* also.

Mandala

The word *Mandala* means covering circular areas or concentric circles. There are five *Mandala* of the eye-

- Pakshma Mandala
- Vartma Mandala
- Shweta Mandala
- Krishna Mandala
- Dristi Mandala

Pakshma Mandala: This is the first and outermost *Mandala* of the eye formed by the *Pakshma* or the eyelashes. This *Mandala* does not appear as a circle when the eye is closed and it is apparently elliptical in shape when the eye is open.

Vartma Mandala: Upper and lower eyelids jointly form a circle in front of the eyeball, which is termed as *Vartma Mandala*. There are two *Nimeshani Siras* in the *Vartma* which performs the function of *Nimesha* and *Unmesha* i.e. blinking. *Vartma Mandala* is the seat of 21 diseases according to *Sushruta* and 24 diseases according to *Vagbhatta*. Upper and lower lids jointly form the two *Vartma Patala* along the orbital margins in front of the eyeball.

Shukla Mandala: *Shukla Mandala* is present just inside the *Vartma Mandala* and beyond the black circle. This portion appears as whitish and therefore known as *Shukla Mandala*. *Sushruta* has described 11 clinical entities in *Shukla Mandala*, while according to *Vagbhata* it is 13 in number. The *Shukla Mandala* can be correlated to the Sclera part of the outer fibrous coat of the eyeball covered with conjunctiva.

Krishna Mandala: The black portion of the eyeball is called as *Krishna Mandala*. The size of this *Mandala* is 1/3rd of the whole Eye. This *Mandala* can be compared with the Cornea; and appears as blackish because of the iris below. Even though it is transparent this *Mandala* encloses *Dristi Mandala* in it and is the seat of four diseases according to *Sushruta* and five diseases according to *Vagbhatta*. *Sushruta* has used the word '*Taraka*' for one structure of Eye, which is also 1/3rd of the total Eye and according to *Dalhana*, it is the black part of the Eye.

Drishti Mandala

Last and innermost circular structure of the Eye encloses *Drishti* in it and hence named *Drishti Mandala*. According to *Sushruta* diameter of this *Mandala* is 1/7th of the *Krishna Mandala* as the same opinion of *Videha* and *Dalhana*. Again it is said to be equal to 1/9th part of the "*Taraka*". The size of the *Drishti Mandala* is equal to the cotyledon of *Masura* and is a hollow structure which has its position inner to *Krishna mandala* seems to be *pupillary* area which is circular in shape. The word *Taraka* has been derived from the word '*Tara*' (star) which should have blinking properties (Sir M. M. William's). Anterior part of the uveal tract has such properties of twinkling i.e. Contraction and relaxation. Dr. Bhaskar Govind Ghanekar – a commentator of *Sushruta Samhita* has clearly named *Taraka* as Iris. The size of the Iris is 1.5 mm larger than the Cornea. Iris has also inner position relative to *Shweta Mandala*. So, different measurement 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 the measurement when the Iris is dilated, while 1/9th of *Krishna Mandala* is the measurement when the Iris is constricted. *Sushruta* in his *Uttara tantra* states that the *Drishti*, encircled by *Drishti Mandala* is equal to the cotyledon of *Masura* (Red Lentil) having *Vivirakriti* (circular and hole like), shines like *Khadyota* (spark like), covered by *Bahya patala*¹³. This dimension of *Drishti mandala* and *Taraka* respectively and cotyledon of *Masura* (L. lacythes) are same as per *Madhukoshakara*. Further the distance between the *Drishti mandala* of two eyes is four fingers.

Sandhi(Joints) of the Netra (Eye)

Sandhi is the junction between the two *Mandalas* and it is important as far as the pathogenesis of the diseases is concerned, because the diseases, of one *Mandala* may spread to another through these junctions. The *Sandhis* are 6 in number.

- Pakshma – Vartmagata Sandhi
- Vartma – Shuklagata Sandhi
- Shukla – Krishnagata Sandhi
- Krishna – Dristigata Sandhi
- Apanga Sandhi
- Kaninika Sandhi

Pakshma–Vartmagata Sandhi

The Union line of *Pakshma Mandala* and *Vartma Mandala* is called as the *Pakshma Vartmagata Sandhi* and it is considered as the lid margin. *Krimigranthi* is a disease that occurs in this particular *Sandhi*.

Vartma–Shuklagata Sandhi

The union line of *Vartma* and *Shukla Mandala* is called as *Vartma Shuklagata Sandhi*. The disease *Parvani* occurs in this *Sandhi*. Fornix of the eyeball where the palpebral conjunctiva is reflected onto the bulbar conjunctiva seems to be *Vartma Shuklagata Sandhi*.

Shukla–Krishnagata Sandhi

xii. Shastri A. D., *Sushruta Samhita*, Part I & II, edited with Ayurveda – Tattva Sandipika, Chaukhambha Sanskrit Sansthan, Varanasi, Reprint – 2005.

The circular line joining between *Shukla Mandala* and *Krishna Mandala* is called as *Shukla-Krishnagata Sandhi*. The disease *Alaji* is the one clinical problem among 9 diseases that occurs in *Shukla-Krishnagata Sandhi* and this junction area can be considered as the Sclero-Corneal junction.

Krishna–Dristigata Sandhi

The union line of *Krishna* and *Dristi Mandala* is called as *Krishna- Dristigata Sandhi*. By considering iris part in *Krishna Mandala*, this *Sandhi* can be explained and the central free margin of the iris, which rests on the anterior capsule of the lens, can be considered as the *Krishna-Dristigata Sandhi*. Otherwise there is no apparent union line between the cornea and pupil.

Kaneenaka Sandhi

Acharya Sushruta has only mentioned the term “*Kaneenaka Sandhi*” without any explanatory words, while *Acharya Dalhana* has clarified by the words “*Kaneekagato nasa sameepavasthiyah*”. It is the medial Canthal area. *Ashrumargas* (Lacrimal passages) are situated in this *Sandhi*. The distance between the two *Kaneenaka Sandhis* of two eye balls is two angulis.

Apanga Sandhi

Dalhana has defined this *Sandhi* as “*Bhru pucchanthatah sthithaha*” i. e. near the *Brhu Puchcha* or towards the temporal bone. It is the lateral Canthal area.

Patala (layers) of the Eye

Patala is one of the structures told by *Sushruta* in *Netra sharira*. Various authors have described and interpreted the concept of *Patala* in their own way and yet no consensus has reached upon among them on this subject. V. S. Apte, in his *Sanskrit – English dictionary* describes the meaning of *Patala* as a film or coating over the eyes. According to *Monier Williams*, it can be considered as a layer of the eyeball. *Patala* means a layer, veil, covering chest, membrane especially of the eyes, and a film over the eyes. So it can be considered as the layers of the eyeball. The thickness of each *Patala* is 1/5th of the *Drishti Mandala*. According to *Sushruta*, there are 6 *Patala* in the eyeball – 2 *Vartma Patala* and 4 *Akshi Patala*. The *Vartma Patala* can be considered as the layers of the *Vartma* i. e. the eyelids and Palpebral Conjunctiva. The four *Akshi Patala* are related to the eyeball itself. The controversy, regarding *Patala* is mainly confined to *Akshi Patala*. In *Ayurveda*, the diseases of *Drishti* are considered as of utmost importance, as the complication of these diseases will lead to absolute blindness. The *Patala* are considered as important as the *Drishti*, because the pathogenesis of *Drishtigata Rogas*, especially *Timira* has been described in terms of involvement of successive *Patala*. The prognosis of the disease also depends upon the involvement of respective *Patala*. *Sushruta* considers different *Akshi Patala* and their constituting factors as shown below

Name	Constituting Factor
1st <i>Patala</i> <i>Raktashrita - Dalhana</i>	<i>Tejas + Jala (Tejojala)</i>

2nd <i>Patala</i> <i>Mamsashrita</i>	<i>Mamsa (Pishita or</i>
3rd <i>Patala</i>	<i>Medas (Medoashrita)</i>
4th <i>Patala</i>	<i>Asthi (Asthyashrita)</i>

Relative Positions of Each Patala

The first or outermost *Patala* is described as “*Tejojalashrita*”. According to *Dalhana*, the word *Teja* means *Alochaka Pitta* and so *Siragata Rakta*(blood) can be taken as *Teja* and *Jala* implies *Rasa Dhatu*. So it can be considered that the first *Patala* is the *Ashraya* for *Rasa* and *Rakta Dhatu*. There will be vitiation of *Rasa* and *Rakta Dhatu*, in all the clinical conditions where first *Patala* is involved. The only clinical feature of first *Patala* pathology is blurred/indistinct vision, which becomes clear sometimes without any reason. As the disease vitiates the superficial *Dhatu*(body constituents) only, the prognosis will be good. The second *Patala* is said to be ‘*Mamsashrita*’ and there will be vitiation of *Mamsa Dhatu* in diseases where second *Patala* is involved. The third *Patala* is described as ‘*Medoashrita*’ and there will be vitiation of *Medo Dhatu* in diseases where third *Patala* is involved. The fourth *Patala* is ‘*Asthyashrita*’. It is constituted by *Asthi* – hard tissue, which is supportive in function. So there is involvement of deeper *Dhatu* as the disease progresses; and accordingly it becomes incurable. First *Patala*, among the four *Akshi Patala*, is known as *Bahya* or outer; this means that the other three are relatively innermost to the former. According to *Sushruta*, the disease *Timira* vitiates the first *Patala*, followed by second, third and fourth *Patala*. Therefore the first *Patala* is considered as the outermost and the fourth *Patala* is considered as the innermost *Patala* according to *Sushruta*.

Aksi Bandhana

Siras, Kandaras, Meda and *Kalkasthi* with their excellent properties, Which they attain inherently keep both eyes in their normal position. *Sleshma* along with *Siras* take part in the *Bandhana Karma* of the eye. Here, *Dalhana* opines that *Sira* in the reference includes both the *Sira* and *Dhamani*, but *Kandara* is meant for *Snayu* and *Peshi*. Thus the different parts of the eyeball are held together by blood vessels, muscles, fat and a black substance. Beyond this black substance, there is a mass of whitish substance through which course the blood vessels.

Siras and Dhamanis

There are 38 *Siras* which transport *Vata* (8), *Pitta* (10), *Kapha* (10) and *Rakta* (10) in both the *Netra*. *Acharya Vagabhatta* has described 56 *Sira*, out of which 4 help in *Unmesha* and *Nimesha* (opening & closure of eyelids)¹⁴. Among 4 *Dhamanis*, there are two *Dhamanis*, one in each eye for *Roopavahana* (Visual impulses) and rest two for drainage of *Ashru* (tears) in the *Netra*.

Peshi and Snayu (Muscles and Tendons) of the Eye

Mandala (circular) type of *Peshi* (muscles) and *Prithu* (broad) type of *Snayu* (ligaments) are found in the eyes. There are present two *Peshi* and thirty *Snayu* in both the eyes. The

Mandalakara Peshi may be Orbicularis Oculi muscles while the *Snayu* may be the tendons of the extra-ocular muscle.

Asthi and Sandhi (bones and joints) of the Eye

There are six *Sandhi* which have been described earlier and a *Tarunasthi* (cartilage) is also present in the *Akshi-kosha* (lids) i.e. Tarsal plates.

Locations of Marma in Eye¹⁵:

Marma are vital points of the body, trauma to which may result in various complications. Two *Marma* mainly *Apanga* and *Avartha* are related to Eye. *Apanga marma* is situated on outer side of the orbits below the lateral end of the eyebrows, $\frac{1}{2}$ *angula* in size and is a *Sira Marma*. *Avartha Marma* is situated above the lateral end of eyebrow, of same size and *Sandhi* type of *Marma*. Any injury to these sites may result in blindness and diminished vision¹⁶. *Shringataka Marma* are four *Sira* types of *Marmas* of *Mushthi Pramana* (fist sized), situated in the middle of the *Sira* supplying nutrition to eye, ear, nose and tongue. Any injury to this *Marma* leads to death.

Colour of Eye and Effect of Tejodhatu on Eye

In foetal life, colour of eye is formed by *Tejdhatu*. This *Tejdhatu* when combines with *Tridosha* and *Rakta*, different colours and disorders are formed in Eye.

When *Tejdhatu* doesn't reach *Drishti bhag* – child becomes congenitally blind. (Congenital Blindness/ Amblyopic)

- *Vatanugat Tejodhatu* causes – *Vikrutakshata* (Squint).
- *Pittanugat Tejodhatu* causes – *Pingakshata* (Yellow coloration)
- *Kaphanugat Tejodhatu* causes - *Shuklakshata*(White coloration)
- *Raktanugat Tejodhatu* causes - *Raktakshata*(Red coloration)

Concept of vision in Ayurveda

Visual perception, like all other sensory phenomena, is dependent upon the state of mind and soul. *Acharya Charaka* has described this process as the conjuncture of soul, mind and the sense organ with the objects¹⁷. *Kashyapa* classifies senses into *Sannikrishta Indriya*(direct contact sense organ) and *Viprakrishta Indriya*(indirect contact sense organ). Eyes and ears are the *Viprakrishta Indriya*, wherein object need not directly fall on the senses. Eye has developed sufficient skills to perceive the object from a sufficiently large distance¹⁸. The theory of *Panchapanchaka* given by *Acharya Charaka* depicts the phenomenon of sensory perception by enumerating the five important factors that take part in this process. They are

xiv. Lahange *et al.* A review study of *marma sharir* with special reference to its clinical importance, World Journal of Pharmaceutical Research, Volume 5, Issue 10, 454-463.

Vagabhata: *Astanga Sangraha* Vol I, By Kaviraj Atrideva Gupta, xv
Krishnadas Academy, Varanasi, 1993 Ed 31.

xvi. *Charaka, Charaka Samhita* with Ayurveda Dipika commentary by Chakrapanidatta edited by Vaidya Yadavaji Tripathi Acharya, Chukahmba Surbharati Prakashan Varanasi, Reprint 2016.

xvii. *Kashyapa Samhita, Vriddha Jeevikiya Tantra* with Vidyotini Hindi commentary Chaukhamba Sanskrit Sansthan, Varanasi. 7TH Edi. 2000.

Indriya, Indriya Dravya, Indriya Artha, Indriya Adhithana and Indriya Buddhi. In case of eye, these factors are as follows:

Table 4. Indriya panchapanchaka of Chakshuyendrya (Eye)

Sr. no.	Indriya panchapanchaka	Responsible factors
1	<i>Indriya</i>	<i>Chakshuyendrya</i> (Eye as sense organ)
2	<i>Indriya Dravya</i>	<i>Teja</i> (energy, fire)
3	<i>Indriya Artha</i>	<i>Rupa</i> (visual sensation)
4	<i>Indriya Adhithana</i>	Eyes (2 <i>Netra/Akshi</i>)
5	<i>Indriya Buddhi</i>	<i>Chakshurbuddhi</i> (knowledge of vision)

Rupa (Indriya Artha) is travelling in the media of *Jyoti (Indriya Dravya)* towards the *Akshi (Indriya Adhithana)*. Impulses from both these *Akshi* are collected at *Chakshuyendrya (Indriya)*, which is one in number. Further it will be analyzed at the level of *Chakshurbuddhi (Indriya Buddhi)* to give actual knowledge of the objects. As *Dosha* pervade all aspects of physiology, their impacts on these processes are worth-knowing to understand ancient considerations of visual perception. *Vata* is responsible for *Pravartana* (stimulation, activation) of the *Indriya* whereas *Pitta* performs *Alochana* (perception) of the *Indriya Artha*.

Kapha bestows *Sthairya* (stability) to the *Indriya Adhithana* by providing *Tarpana*(nutrition). Further, the subtypes of *Dosha* like *Prana Vayu* and *Vyana Vayu* are specifically held responsible for *Vata Karma, Alochaka Pitta* for *Darshana* and *Tarpaka Kapha* for *Akshi Tarpana*¹⁹.

Netra Roga (Diseases of Eye)

Most of the authors have classified the eye diseases according to the site of occurrence of the diseases. The eye diseases according to various ancient scholars are tabulated as follow:

Table 5. The various numbers of Netra roga According to different Acharyas

Sr. no.	Name of Acharya	No. of Netra roga
1	<i>Acharya Sushrut</i>	76
2	<i>Acharya Charak</i>	4
3	<i>Acharya Vagbhata</i>	94
4	<i>Acharya Sharangdhar</i>	94
5	<i>Acharya Bhavprakash</i>	78
6	<i>Acharya Yoga Ratnakar</i>	76

Table 6. Distributions of Netra Roga on the basis of location and according to different Acharya

Sr. no.	Location of Netra Roga	SS	AS	AH	MN	YR	BP	Sa.S	KT
1	<i>Vartimagata Rogas</i>	21	24	24	21	21	21	24	27
2	<i>Pakshmagata Rogas</i>	-	-	-	02	02	02	-	-
3	<i>Sandhigata Rogas</i>	09	09	09	09	09	09	09	09
4	<i>Suklagata Roga</i>	11	13	13	11	11	11	13	13
5	<i>Krishnagata Roga</i>	04	05	05	04	04	04	05	06
6	<i>Dristigata Roga</i>	12	27	27	12	12	12	27	25
7	<i>Sarvagata Rogas</i>	17	16	16	17	17	17	16	16
8	Others(Bahya)	02	-	-	02	02	02	-	-
9	Total	76	94	94	78	78	78	94	96

(Note: SS = *Sushruta Samhita*, BP = *Bhavaprakash*, AS = *Astanga Sangraha*, Sa. S = *Sharangadhara Samhita*, AH = *Astanga Hridaya*, MN = *Madhava Nidana*, KT = *Karala Tantra*, YR = *Yoga Ratnakara*)

xviii. R. K. Sharma, *Charak Samhita With "Ayurvedeepika" Commentary hakrapanidutta, Chaumbha Publication, Vol- IV, 1st Edition, 1997.*

Table 7. Netra roga sankhya(number of eye diseases) according to Dosha predominance

Sr. no.	Type of Netra roga (Eye diseases)	Sankhya (number)
1	Vataj Netra Rog	10
2	Pittaj Netra Roga	10
3	Kaphaj Netra Roga	13
4	Raktaj Netra Roga	16
5	Sarvaj Netra Roga	25
6	Bahyaj Netra Roga	02
	Total	76

Acharya Videh has also described 76 types of Netra Roga. Acharya Satyaki has described 80 types of Netra Roga while Acharya Karal has described 96 types of Netra roga.

DISCUSSION

This review study has witnessed to assess the concept of Eye from different point of view viz. Eye from anatomical, physiological, pathological, optic nerve & retina, lens and pupil point of view. Anatomically and functionally *Dosha & Mahaboota* are important in formation of Eye. In the discussion unit I will go through the various references of Eye available in the historic, *Samhita* and present daily modern texts. To start with, the references of Eye are available in the text of *Rigveda*. In *Rigveda* the *Ashvini* brothers revived the eyesight of *Rujrasva Kakshivat* and *Kanva*²⁰. In *samhita* period the references of Eye are available in *Charaka*, *Sushruta* and *Vagabhatta* but complete and elaborated description is available *Sushruta Samhita*. He has said that the *Tejas dhatu* is responsible for the quality of Eye during the intra uterine life. *Tejas dhatu* is *Agni Mahabhoot* so *Pitta* is the main *Dosha* responsible for the quality *Drishti* in the intra uterine life. *Sushruta* has described predominance of different *Dosha* prominently showing the colour of the eye with respective *Dosha*. According to *Sushruta* measurement of *Drishti* has described that the breadth of central part of individuals own thumbs the Vertical diameter is two fingers; its Horizontal diameter measures two & half fingers. Modern literature has also confirmed the above facts.

Further measurement *Krishanmandal* and *Drishtimandal*, he said that the measurement of *Drishti* as 1/7th of *Krishna Mandala*, in *Uttartantra*. But in *Sutrasthana*, it is described as 1/9th of *Taraka*. Here the meaning of *Taraka* was given as *Krishna Mandala*. So different measurements for the same structure given by the same author points that *Drishti* is a constricting and dilating structure and this also denotes to the pupil. So 1/7th of *Krishna Mandala* is the measurement when the iris is dilated, while 1/9th of *Krishna Mandala* is the measurement when the iris is constricted. Regarding description of *Mandal & Patalas*, *Sushruta* has said that the eye consist of five *Mandala*, Six *Sandhis* & Six *Patalas*. According to *Sushruta*, there are 6 *Patala* in the eyeball – 2 *Vartma Patala* and 4 *Akshi Patala*. The *Vartma Patala* can be considered as the layers of the eyelids and palpebral conjunctiva. The *Patala* are considered as important as the *Drishti*, because the pathogenesis of *Drishtigata Rogas*, especially *Timira* has been described in terms of involvement of successive *Patala*. The prognosis of the disease also depends upon the involvement of respective *Patala*. While describing the part of eye ball *Acharya Sushruta* has said that- In eye, *Mandal* are five in number.

External two *Mandal* are *Paksham & Vartma Mandal*. In modern literature we correlate them with eyelashes and eyelids. Third is *Shukla Mandal* which is present just inside the *Vartma Mandala*. This portion appears as whitish. In modern literature the *Shukla Mandala* can be correlated to the Scleral part of the outer fibrous coat of the eyeball covered with conjunctiva. Fourth *Mandala* is *Krishna Mandala*. The black portion of the eyeball is called as *Krishna Mandala*. The size of this *Mandala* is 1/3rd of the whole Eye. This *Mandala* can be compared with the Cornea; and appears as blackish because of the iris below. Even though it is transparent this *Mandala* encloses *Dristi Mandala* in it and is the seat of four diseases according to *Sushruta*. Last and innermost circular structure of the Eye encloses *Drishti* in it and hence named *Drishti Mandala*. *Drishti* is *masurdal matrum* in appearance & *Vivarakrit*(hole). These two qualities are present in the pupil only. So *Drishti mandal* can be compared with the pupil. According to *Sushruta* measurement of *Drishti* has described that the breadth of central part of individuals own thumbs the Vertical diameter is two fingers; its Horizontal diameter measures two & half fingers. Modern literature has also confirmed the above facts. In modern literature Vertical diameter is approximate 23.00mm & Horizontal diameter is approximate 23.5mm and antero-posterior length is 24mm. So it is fully relevant today. It is similar in millimeter dimension of modern literature²¹. The different scholars have given different meanings or definition of the *Drishti*. These descriptions are available in brief and *Sutra* form. The most authentic description of *Netra Sharir* (anatomy of eye) is available in *Sushruta Samhita* in *Uttartantra*, supposed to be written in B.C.2000 by *Acharya sushruta*. So it is needed that there should be a complete and elaborated study of the Eye.

Conclusion

Science is the intellectual process for using all of the mental and physical resources available in order to better understand, explain, and predict normal as well as unusual natural phenomena. In other words, science is the light thrown on silent facts. *Ayurved* as a science has lots of such silent or hidden facts. *Ayurveda Acharya* have clearly stated that whatever is written is open for further enrichment by the persons who know about the subject. Though anatomy of eye does not seem to be fully explored in *ayurveda*, but writing of *Acharya* has laid the foundations in all its aspects. So today, there is a need to review the *Ayurvedic* principles of *Sharir Rachana* & form solid practical principles in the field of ophthalmology in present era. Thus there is a need to study of each and every anatomical structures of Eye explained in different *Samhita* and comparison with modern anatomical knowledge for the enhancement of science and health of human being.

REFERENCES

- i. M. Loukas, Anatomy in ancient India: a focus on the Susruta Samhita, journal of anatomy, 2010 Dec; 217(6): 646–650.
- ii. Sandeep *et al.* A critical review study on dissection techniques in ancient Indian Anatomy in context to its

xix. *Rigveda* edited by Pandit Shreeram Sharma, Brahmvarchas, Haridwar, 5TH edition, 2002,

xx. Tortora G.J., Principles of Anatomy and Physiology, Harper Collins College Publishers, 8th Ed. 1996.

- clinical significance, World Journal of Pharmaceutical and Medical Research, 2017,3(9), 371-375
- iii. Lahange *et al.* analytical outlook on concept of foetal anomalies in *ayurveda* with special reference to its etiopathogenesis, European Journal of Pharmaceutical and Medical Research, 2017,4(05), 289-295
- iv. Susruta: Susruta Samhita: with commentaries Nibandhasamgraha by Dalhana and Nyayacandrika by Gayadasa : Chaukhamba Orientalia, Varanasi : 5th Ed. (reprint 1992),
- v. *Bhela, Bhela Samhita* edited by Shri Girija Dayal Shukla, Chaumkhambha Vidya Bhavan, 1st edition, 1969.
- vi. *Charaka, Charaka Samhita* with Ayurveda Dipika commentary by Chakrapanidatta edited by Vaidya Yadavaji Trikaji Acharya, Chukahmba Surbharati Prakashan Varanasi, Reprint 2016.
- vii. ¹ *Sushruta, Sushruta Samhita* of Maharshi Sushruta, Kaviraja Ambikadutta Shashtri, edited with Ayurveda-Tattva-Sandipika foreword by Dr. Pranajivana Manekchanda Mehta Chaukhambha Sanskrit Sansthan reprint edition, 2008.
- viii. *Charaka, Charaka Samhita* with Ayurveda Dipika commentary by Chakrapanidatta edited by Vaidya Yadavaji Trikaji Acharya, Chukahmba Surbharati Prakashan Varanasi, Reprint 2016.
- ¹ Mitra J., Ashtanga Sangraha, Induvirachit 'Sashilekha' Vyakhya Samanvitha, Chaukhambha Sanskrit Series office, Varanasi, Ist ed – 2006.
- ix. Brahma Vidya khand, 108 *Upanishada* by edited by Pandit Shri Ram Sharma Acharya, Sanskriti Sansthan, Barielly, Reprint edition 4th, 1969.
- x. Ghanekar B.G. , Sushruta Samhita Sharirasthan , Meharchand ,Lachmandas Publications, New Delhi-2006 .
- xi. Susruta: Susruta Samhita: with commentaries Nibandhasamgraha by Dalhana and Nyayacandrika by Gayadasa : Chaukhamba Orientalia, Varanasi : 5th Ed. (reprint 1992),
- xii. *Vikash Bhatnaga*, a review study on the concepts of human anatomy in ayurveda, *International Journal Of Current Medical And Pharmaceutical Research*, Vol. 3, Issue, 04, pp.1598-1603, April, 2017
- xiii. Shastri A. D., Sushruta Samhita, Part I & II, edited with Ayurveda – Tattva Sandipika, Chaukhambha Sanskrit Sansthan, Varanasi, Reprint – 2005.
- xiv. Astanga Hrudaya, Dr. Anna Marishwar Kunthe, Chaukhamba Surabharati Prakashana, Varanasi 2002. Pandit Haragovinda Shastri, Amarakosha Ed 1997.
- xv. Lahange *et al.* A review study of *marma sharir* with special reference to its clinical importance, World Journal of Pharmaceutical Research, Volume 5, Issue 10, 454-463.
- xvi. Vagabhata: Astanga Sangraha Vol I , By Kaviraj Atrideva Gupta , Krishnadas Academy , Varanasi, 1993 Ed 31.
- xvii. *Charaka, Charaka Samhita* with Ayurveda Dipika commentary by Chakrapanidatta edited by Vaidya Yadavaji Trikaji Acharya, Chukahmba Surbharati Prakashan Varanasi, Reprint 2016.
- xviii. Kashyapa Samhita, Vruddha Jeevikiya Tantra with Vidyotini Hindi commentary Chaukhamba Sanskrit Sansthana, Varanasi. 7TH Edi. 2000.
- xix. R. K. Sharma, Charak Samhita With“Ayurvedeepika” Commentary hakrapanidutta,Chaumbha Publication, Vol- Iv, 1st Edition, 1997.
- xx. *Rigveda* edited by Pandit Shreeram Sharma, Brahmvarchas, Haridwar, 5TH edition, 2002,
- xxi. Tortora G.J., Principles of Anatomy and Physiology, Harper Collins College Publishers, 8th Ed. 1996.
