

Commissioned Article

Ophthalmology in ancient time – the *Sushruta Samhita*

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Sushruta, who lived during 600 BC, had vast knowledge of medicine and surgery mainly based on Ayurveda. His works have been recorded in *Sushruta's* compendium which is said to be one of the oldest treatises available on medicine/surgery. Based on the compendium, we can assume that some form of medical knowledge must have existed in India much ahead of *Sushruta's* time. Diseases, their pathogenesis, signs and symptoms, treatment, and complications are described in such a depth that it leaves us wondering as to how *Sushruta* could have developed precise clinical skills simultaneously in all parts of medical science including medicine, surgery, plastic surgery, anesthesia, ophthalmology, midwifery, genetics, anatomy, and diabetes.

Key words: Ophthalmology, *Sushruta*, *Sushruta Samhita*

The history of civilization in India starts >5000 years ago. There are records that for over 2500 years, Ayurveda existed as the mainstay of health care in India. This system was influenced, over time, by the migrants from different countries. Later on, this system was highly influenced by the Western medicine, especially after arrival of the British. Since then, India has greatly developed in medical science. However, one should not forget that the root of today's medicine lies in the past. One of the richest records of the ancient Ayurveda is the *Sushruta Samhita* which demonstrates that the knowledge on medical science in ancient India was ahead of other contemporary systems that existed in different societies. This article tries to explore the advancement of medical science in Ayurveda system.

Prehistoric Era of Ancient India

The first urbanization of India took place during the Bronze Age known as the Indus or Harappan civilization which flourished during 3500–1500 BC. The rest of India during this period was inhabited by Neolithic (new stone age) and Chalcolithic (stone – copper age), farmers and Mesolithic (mid-Stone Age), hunter-gatherers. Iron technology was introduced about 3000 years back which brought development of the Eastern part of India. This was the era which witnessed the Mahabharata epic.^[1]

By 1500 BC, the Aryans had already invaded India and gained power by driving the Dravidians (aborigines) southward. They, then, migrated to major parts of India. Their society consisted of extended families or cluster

of related families which formed a village while several villages formed a tribe. As their settlements were of permanent nature, trading started within different occupations. The river Ganga became a trade route. The trade was not limited within the country. It occurred with the Egyptians, the Persians, and others in the Middle East. The Aryan rajas (kings) were primarily powerful military leaders. Nonetheless, they avoided conflict with priests whose knowledge and religious life surpassed others in the community and thus the rajas had to compromise at the end. The priests held a high position in the court and were placed next to the kings.^[2]

Medicine in Ancient India

Before Aryans, a priest held a superior position to a surgeon. They used curative spells and healing mantras instead of medicinal knowledge. The healers were divided into five categories, namely, *Rogaharas* (physicians), *Shalvaharas* (surgeons), *Vishaharas* (poison curers), *Krityaharas* (demon-doctors), and *Bhisag-Atharvans* (magic doctors).^[3]

But during Aryan times, these people were assailed and surgeons replaced them as they were more helpful in serving in wars. There are records that 3000 years ago, the amputated legs were replaced by iron substitutes, injured eyes were plucked out, and arrow shafts were extracted from the limbs of Aryan warriors.

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Here, I would like to put forth few interesting historical events which the Hindus are well acquainted with. In Ramayana, there is a mention of well-organized system of treatment along with the description of Sanjeevani: A rejuvenating herb found in the Himalayas. Another myth is related with Mahabharata where Bhishma Pitamha lied on the bed made of arrows after being severely injured in the famous war so that he could rest till he died at his will (he was blessed with willful death).^[4-6]

Does this mean that 5000 years back (during Mahabharata era), there existed some form of external fixation technique for fractures? That they knew a rejuvenating herb hidden in the Himalayas (during Ramayana period) which we are still unaware of? Did they know more than what is really found in the remains of that era?

It is well recorded in various parts of the world that death and diseases exist since the advent of living being. Our primitive ancestors acquired this knowledge by following the examples of lower animals in disease and their curiosity broadened their knowledge about the properties of many valuable medicinal drugs based on plants, animals, and minerals available locally.

The art of medicine practiced in ancient India dates back to earlier than 6000 years BC while that in Egypt to 3000 BC or earlier. The Greeks and the Romans borrowed a lot from the Egyptian medicine. In fact, the Egyptian medical men were invited to Greece to practice there and were highly respected. Similarly, during the eighth century, Indian and Greek medical men were invited by Persian Kings and were given a high post in their court.^[7]

Sushruta

During 600 BC, major part of ancient India was ruled by Indo-Aryans. At this time, the caste system was emerging (with Brahmin priests being at the top) and Upanishads (commentaries on Vedic rituals and philosophical treatises) were being composed in Sanskrit. During this time, an intelligent person was born who was called *Sushruta* – meaning well heard.^[2]

It is assumed that *Sushruta* was born in the Eastern part of India near Bihar (which was famous for sacred schools and universities at that time). *Sushruta* was a physician by occupation. In Mahabharata, he is represented as a son of Rishi Visvamitra. Since wars of Mahabharata took place during 3000 BC^[1], it is assumed that he was the clan of Vishvamitra.^[8]

Sushruta learned medicine and surgery from the king of Varanasi, Divodasa. He wrote the *Sushruta Samhita* which is one of the most important surviving ancient treatises on medicine based on Ayurveda.^[8] *Sushruta* is attributed with the glory of discovering the art of cataract-couching which was unknown to the surgeons of ancient Greece and Egypt. In his realm, limbs were amputated; abdominal sections were performed; fractures and dislocations were set; hernia and ruptures were reduced; and hemorrhoids and fistula were

removed. Even the first successful graft (earlobe and nose) were performed. He was even aware of the fact that the angle of reflection is equal to the angle of incidence and that the same ray which impinges on the retina serves the double purpose of illuminating the eye and the external world and is in itself converted into the sensation of light.^[3]

He was a good teacher as well. He made the students practice on dummies and anatomy was studied by dissecting lower animals. *Sushruta* preached that the theory without practice is like a one-winged bird that is incapable of flight.^[3]

The Sushruta Samhita

His *Samhita*, divided into six volumes, comprises all aspects of general medicine. However, due to an extraordinary accuracy and detail of surgery in his work, he is also considered as the father of surgery.^[9]

These six volumes contain 184 chapters describing 1120 illness, 700 medical plants, 64 drugs prepared from minerals, and 57 from animal sources. It also discusses different surgical techniques suitable for different body parts along with 14 different types of bandages. Mostly, the *Samhita* focuses on surgery and midwifery, but it also deals with topics such as genetics, mental illness, embryology, anatomy, geriatric illness, and diabetes.

It has 300 surgical procedures and it classifies surgery into five subheadings such as *Aharya* (extraction of solid bodies), *Bhedyā* (excising), *Chhedyā* (incising), *Eshya* (probing), *Lekhya* (scarifying), *Sivya* (suturing), *Vedhya* (puncturing), and *Visravaniya* (evacuating fluids). It describes more than 300 kinds of operations that call for 42 different surgical processes and 121 different types of instruments.^[10]

For the purpose of anesthesia, he advised the use of wine with the incense of cannabis and this is the oldest form of anesthesia used with no world record before that.

The instruments used for surgeries were constructed after the shape of beasts and birds and named after them like the crocodile forceps and hawk's bill forceps.

Sushruta dealt with easier illness in the first five subdivisions of his *Samhita* reserving the discussion of those requiring advanced knowledge and skill in *Uttaratantram* which includes ophthalmic surgery, laryngotomy, and fever therapeutics. It was more of a supplement instead of the main course at that time.

In its English translation by Kaviraj Bhisagratna, ophthalmology is discussed in the third volume. Here, we find the classification of diseases of the eye in the first chapter. The next few chapters discuss the pathology of diseases according to the anatomical site of the eye. In the 8th chapter, it discusses about the classification of the treatment of eye diseases: curable, incurable, and those in which operations were not to be risked. This is followed by chapters consisting of treatment of different eye diseases. The 18th chapter describes

the preparation of drugs for eyes and the 19th chapter, the last one, discusses about ocular trauma.

Of the 76 varieties of ophthalmic diseases, 51 are surgical. The mode of operation which is to be performed in each case has been elaborately described in the *Samhita* and, in most instances, can be compared with modern methods of ophthalmic surgery.

The eyeball (*Nayana-Budbuda*), as described by *Sushruta*, is two fingers in transverse diameter, breadth of one's own thumb in depth (sagittal diameter), and two fingers and a half all round (in circumference). It is made up of all the five primary elements of the universe which includes the solid earth (*Bhu*) forming the muscles, heat (*Agni*) forming the blood, the gas (*Vayu*) forming the iris in which the pupil is situated, fluid (*Jala*) forming the vitreous, and the void space (ethereal *akasa*) forming the lacrimal apparatus and other ducts and sacs. The major division of the eye consisted of five mandala (subdivision of circles of eyeball which includes Krishna mandala – the choroid layer and other four which are shown in Figure 1), 6 sandhis/joints (where the subdivision meets one another), and 6 patalas (layers or coats).^[3]

The main culprits of eyes diseases, according to *Sushruta*, are diving in water after prolong exposure to heat/sun, constant near or far gazing, sleep during day and waking up late nights, grief, worry, alcohol consumption, trickling of sweat in the eyes, dust/smoke exposure, excessive vomiting, etc. There are 76 kinds of eye diseases [Table 1] mentioned along with their pathology and symptoms, signs, and treatment. Everything explained in precise detail is what makes us wonder if it's for real that this vast knowledge existed in that ancient time.

Different treatment modalities are described such as medicinal measures (*Kriya*), soothing (*Tarpara*), sprinkling (*Seka*), eye drops (*A'schyotana*), and eye slaves (*Putapakas Anjanas*). Most of the time, the treatment for ophthalmic diseases was done by laying the patient in a dark chamber not exposed to the sun and the gusts of wind after having been treated with proper emulsive measures (*snehakarma*) and subjected to a course of emetics and purgatives. Most of the time, at the end of surgery, a paste of honey and clarified butter were applied and then the eye bandaged.

Even the management of overtreatment and undertreatment is described in each section along with the management of surgical complications like vitreous hemorrhage.

Table 1: Types of eye diseases based on locality

| Number of diseases | Locality |
|--------------------|-----------------------------------|
| 9 | Sandhis: Binding unions |
| 21 | Vartma: Eyelids |
| 11 | Sukla-bhaga: Vitreous |
| 4 | Krishna-bhaga: Choroid |
| 17 | Eyeball |
| 12 | Region of drishti: Pupil and lens |

The drugs were based on animal, plant, or minerals. The animal part consisted of flesh of vulture, beef flesh, deer flesh of Ena species, lards of snakes and cocks, meat juice (beef), urine, bone of nocturnal birds, oyster shells, cow dung, etc. It has been recorded that powder of precious gems such as gold, silver, and ruby were also used.

To hang the hard veins (blood vessels), hooks were used. Scrapping of different parts was done by round-topped instruments. The *Mandalagra yantra* was used for the pterygium. For incision, different knives were used. Cauterization was done with red hot rod. In case of certain diseases such as diseased cyst (*Bali*), cauterization with alkali (caustic), or fire was done after retracting the lids with hooks. For every surgery, instruments were designed differently and described in detail few examples of which are shown in Figure 2.^[3] He has also mentioned about the use of sharp and blunt instruments in ophthalmic surgery along with its complication.

For some eyelid surgeries, the lid area was divided into two parts at the junction of lower 1/3rd above the eye lashes and upper two third below the eyebrow. This was the landmark for an incision. This 'incidental ulcer' was then sutured with a horse's hair and attached to a piece of linen, tied round the forehead.

Palliative measures in case of *Timira* (incurable diseases) marked by redness of the eye, leeches were applied to the affected region to relieve it of exuberance of the *Dosha* in case of emergency.

As an ophthalmologist, we are all well aware of the process known as couching which originated in India. It is still practiced in some rural parts of India. Different needles, which were either straight or slightly curved, were used by *Sushruta* according to the nature of the lens material (milky, gray, and fluffy). *Yuv-vakra salaka* is one example used for cataract.

The needles, used for cataract surgery, had to be made up of gold, iron or copper. They had strings around the other end. The technique of couching is described beautifully in the *Samhita*. The left eye was operated with the right hand and vice versa.

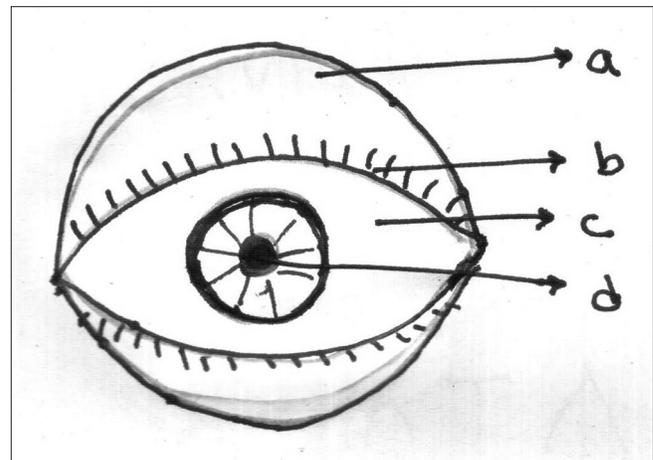


Figure 1: The four mandalas. (a) Vartma mandala-lid. (b) Pakshma mandala-lashes. (c) Sveta mandala-cornea and sclera. (d) Drishti mandala-pupil

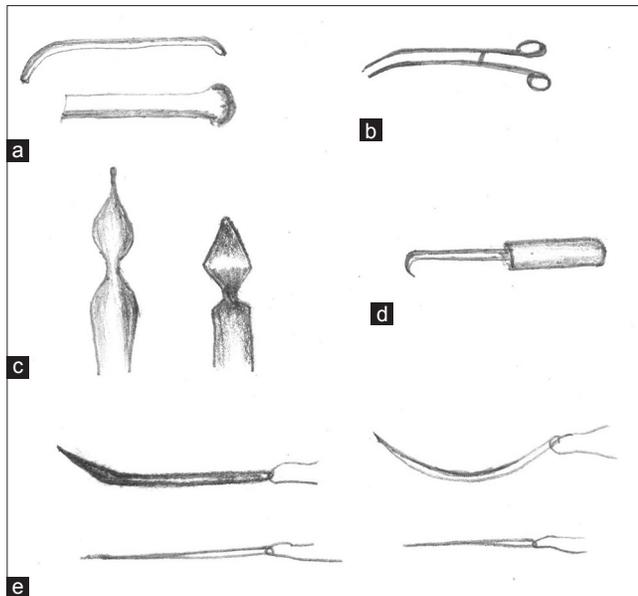


Figure 2: Surgical instruments: (a) *Shalaka yantra*. (b) *Aahmaryaharna yantra*. (c) *Yuv-vakra salaka*. (d) *Mandalagra shastra*. (e) *Suchi shastra*

The needle was inserted at the exact site as described. The success of the operation was presumed from the characteristic report or the sound and the emission of a drop of water from the affected region following perforation. Then the eye was fomented with the needle *in situ*. The mucus accumulated in the affected eye after the surgery was removed by asking the patient to snuff it off by closing the nostrils on the other side of the operated eye ball. The eyes were bandaged after application of emulsions (ghee and honey), and removed every 4th day and fomented till the 10th days of surgery. If the surgery is not done properly, blood would come out from the perforated site which should be then sprinkled with breast milk and bandaged.

The *Sushruta Samhita* provides a systematic method of arranging the surgical experience of the old surgeons and collects the scattered facts of medicine from the vast range of Vedic literature.

The first translation of this book from Sanskrit took place in 8th century in Arabic on the order of the Caliph Mansur. It was called “*Kitab-i-Susrud*.” Later on, it was translated into Latin by none other than Sir William Harvey,^[10-12] and in German and English too.^[13] The most recent English translation was done by Kaviraj Bhishagratna published in 1910. The only conclusive text book available in written form is the Bower manuscript which is in Sanskrit and in Brahmi script.

Conclusion

Sushruta, who lived centuries before Hippocrates and in an era of limited knowledge and technical supplies, practiced medicine and performed precise surgeries with vast knowledge of *ayurveda*. His knowledge has served as founding blocks to the modern day’s medicine and surgery. I want to emphasize that his contribution to humanity in general and the medical science in particular should not be forgotten. We should

appreciate this great personality with respect and shouldn’t let him fade away in the limelight of the modern world.

At the end, I want to quote the exact words of Frank McDowell who described *Sushruta* as followed:^[14]

“Through all of *Sushruta*’s flowery language, incantations and irrelevancies, there shines the unmistakable picture of a great surgeon. Undaunted by his failures, unimpressed by his successes, he sought the truth unceasingly and passed it on to those who followed. He attacked disease and deformity definitively, with reasoned and logical methods. When the path did not exist, he made one.”

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