

Shalya Tantra - The Ayurvedic Surgical Branch – A Literary Review

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Abstract

Ancient Surgical science -Shalya Tantra embraces all processes aiming at the removal of factors responsible for producing pain or misery to the body or mind. Sushruta took surgery in medieval India to admirable heights and that era was later regarded 'The Golden Age of Surgery' in ancient India. The association of Plastic Surgeons of India offers their salutations to this great Ayurved surgeon by giving him a proud position in the association's emblem. In this review an attempt has been made to highlight the ancient surgical concepts of Sushruta Samhita (Ayurved Medical text) which are practicing today with little modification.

KEYWORD: Ayurved, Shalya Tantra, Surgery, Sushruta

Introduction:

Regarding the origin of Medicine it is considered that there are no written records. Pre Vedic history would be from the earliest times to the Indus Valley Civilization & then to the Vedic period. During this period disease was considered as magic religious phenomenon. Ayurveda is a system, that helps maintain health in a person by using the inherent principles of nature to bring the individual back into equilibrium with their true self. ^[1] In essence Ayurveda has been in existence since the beginning of time because we have always been governed by nature's law.

Shalya Tantra – The scope of this branch of Medical Science is to remove (from an ulcer) any extraneous substance such as, fragments of hay, particles of stone, dust, iron or bone; splinters, nails, hair, clotted blood, or condensed pus (as the case may be) or to draw out a dead fetus of the uterus, or to bring about safe parturitions in cases of false presentation, and to deal with the principle and mode of using and handling surgical instruments in general, and with the application of heat (cautery) and alkaline (caustic) substances, together with the diagnosis and treatment of ulcers.

When we list out the first to contribute in surgery, in all those first's Sushruta's name is seen, like first to describe dissection, absorbable suture material, instruments, operative procedure for specific diseases. Like this the list almost seems to be so much which shows the contribution of Indian sciences in medical field. Sushruta Samhita, a systematic study of surgery (General, Orthopedic, Plastic, Gynaecology, ENT, Ophthalmology, etc) is the earliest treatise and also the best which deals with the surgery particularly the principles of surgery in detail.

Historical background:

The *Rigveda* and *Atharvaveda* are the chief sources of information regarding medicine during the Vedic period. In *Rigveda*, we find that legs were amputated and replaced by iron substitutes, injured eyes were plucked out and arrow shafts were extracted from the limbs of the Aryan warriors. In India, curative spells and healing mantras preceded medicine, ^[2] and the first person of medicine in India was priest, a *Bhisag Atharvan*, who held a top position to a surgeon in Society. In *Rigveda* occasional references to the diseases and their causes are found scattered. The

Kaushika Sutra of Atharvaveda has references regarding *Vrana* (wound). The patient should be given pepper corns to eat, if wound is open one and if wound is closed, treated by *jalasa* (cow's urine). A detailed description of *Vrana* is available in the *Sushruta Samhita*, *Charaka Samhita* and *Astanga Sangraha*. Later authors follow the wordings of triologies. Sushruta has attributed many chapters on the concept of *Vrana*.

Mention of Ayurvedic Shalya Tantra word doesn't complete by without the mention of Great Ancient Surgeon, Sushruta. It is only safe to assert that Sushruta was of the race of Vishwamitra. The Mahabharata represents him as a son of that royal sage. This coincides with the description given of him in the present recession of the *Samhita*. The Garuda purana places Divodasa as fourth in descent from Dhanvantari, the first profounder of medical science on earth, whereas the *Sushruta Samhita* describes the two as identical persons. There is no ground whatever to suppose that Sushruta borrowed his system of medicine from the Greeks. On the contrary, there is much to tell against such an idea -Weber's History of Indian Literature. [3] Hermann Schelenz (1904) in his book 'Geschichte pharmzie' concludes that "The Indians are one of oldest civilized people on earth. Apparently it was they who kindled the light of science for the world."

There are coincidences in science as in art and philosophy Gravitation and circulation of blood were known to the Indians long before the births of Newton and Harvey in Europe. [4] The *Harita Samhita*, which according to certain scholars is older than the *Sushruta Samhita*, refers to the circulation of blood in describing *Panduroga* (Anaemia). The disease, he observes, is caused by eating clay which thus blocks the lumen of vein and obstructs the circulation of blood. Bhavamishra, the celebrated author of *Bhavaprakasha*, and who is a century older than Harvey, has the above couplets bearing on the subject. [5]

The source book of Plastic Surgery-by Frank Mcdowell aptly salutes and describes "Sushruta as-through all of Sushruta's flowery language, incantations and irrelevancies, there shines the unmistakable picture of a great surgeon. [6] Undaunted by his failures, unimpressed by his success, 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." Hence it was obvious that Sushruta was the great plastic surgeon. [7]

Supremacy of Shalya Tantra:

Sushruta was emphatically a surgeon, and *Sushruta Samhita* is only complete book we have which deals with the problems of practical surgery and midwifery. Sushruta may be attributed the glory of elevating art of surgery as one of the top branches in medical field in his era which was at its peak. *Sushruta Samhita*, a treasure by Sushruta to the medicos is considered as Bible for learning the Shalya Tantra branch of Ayurveda. As this branch is about Surgery in total, practical surgery requires a good knowledge of practical anatomy.

Anatomical Knowledge in Ancient time:

This quote by Somerset Maugham [8, 9] "You will have to learn many tedious things, which you will forget the moment you have passed your final examination, but in anatomy it is better to have learned and lost than never to have learned at all." First reference of dissection of dead bodies is found in this treatise. The *Paruschittas* (Dissector) of ancient Egypt perhaps learnt their art from the *Paruschittas* (Dissector) of ancient India.

Dissection of Dead body in Ayurveda:

For the landmark and knowledge of anatomy Sushruta described the dissection of body and also procedure to preserve the dead body.^[10] For a surgeon, anatomical knowledge is the core of his study without which his work will be like slaughter's job. A sound anatomical knowledge abets to achieve proficiency in art of surgery. Sushruta, an empirical thinker, research minded and man with in depth knowledge quotes several verses on how to preserve the deceased, which in due course of time to be used in gaining the anatomical knowledge. Although the age old method of preservation seems to be crude yet it is an important one. Method of dissection was so precisely stated in the texts, the same method being employed in modified manner in recent times. Starting from selection of deceased body to its preparation for dissection is quite brilliant. Ancient scholars were having so minute observation and were practical oriented. He further states, anyone desirous of acquiring a thorough knowledge of anatomy should prepare a dead body and carefully observe (by dissecting it) and examine different parts.

Ancient Instruments used for surgery:

Surgery can't be thought of without use of instruments. Surgical instruments are the means of extracting the Shalya (any foreign or extraneous substances which troubles the body and mind alike) from its seat or place where it is embedded.^[11] This definition depicts the broader sense of the term 'instruments' not limiting it to the physical materials. To clarify further, like for e.g. Sorrow is also a Shalya, as it harms the body; to extract this sorrow (Shalya) from the body joy (instrument) is to be used.

Sushruta elucidate 101 instruments and Vagbhata mentions it's innumerable. The names of the instruments are given as per their shapes resembling to the animals, birds etc. e.g., *Simhamukha* (Lion Forceps), *Shararimukha* (like Sharari bird -Scissor). This unique way of naming surgical tools after the animals or birds are adopted even today.^[12] His *Samdamsa Yantras* are the first forms of the modern surgeon's spring forceps and dissection and dressing forceps. Diagnostic instruments like *Nadiyantra* and their principles were first laid down by Sushruta, which took several modifications with advent of technology to attain present form of Endoscopes.

Sterilisation & Antiseptic measures:

The instruments advocated for surgical procedures should be heated prior to their use otherwise there is danger of pus formation.^[13] Sharangadahara advises to disinfect a sick room by the fumes caused by burning the following substances with ghee: peacocks feather, Neem leaves (*Azadirachta indica*), Pepper, asafoetida, jatamansi (*Nardostachys jatamansi*), seeds of shalmali (*Bombax malabaricum*), and goat's hair.^[14] Sushruta advises fumigation of a sick room for a surgical patient for ten days, morning and evening, after the operation has been performed.^[15] The surgeon should cut short his hair, nails and should wear white sterilized clothes.^[16]

Yogya-Learning the Practical surgery:

To attain efficiency in surgical operations, the medicos of Dhanvantari were asked to try their knives repeatedly first on natural and artificial objects resembling the diseased parts of the body before undertaking an actual operation. Eg: Incision was practiced on *pushpaphala* (*Cucurbeta maxima*) Alabu (*Longenaris vulgaris*), venesection was practiced on the vessels of dead animals and on the stalks of the water-lily.^[17]

Trividha Karma-Three Operative procedures:

'Trividha' means three types and the word 'Karma' means Operative procedure. The three types of procedure is nothing but the pre-operative, operative and post-operative procedures, a systematic portrayal of surgery. ^[18] Whichever the surgical procedure may be it has the above said three parts in it. Pre-operative means not only related to preparation of patient. Sushruta stresses the importance of collecting all the materials needed during the operative procedure and for post operative care.

Purvakarma (Pre Operative):

Sushruta gives us a list of appliances required in surgical operations: ^[19] Blunt Instruments, Sharp Instruments, Potential Cautery, Actual Cautery, *Shalaka* or Rods, Horns, Leeches, Hollow Bottle Gourd, *Jambav-Oushta* (A Bougie of Blackstone, extremity of which is shaped like the fruit of Jambul Tree (*Urginea jambolana*), Cotton, Pieces of Cloth, Thread, Leaves, Materials of Bandaging, Honey, Ghee or Clarified Butter, Suet, Milk, Oils, *Tarpan*- Flour of any perched Grain or Condensed Milk Etc. Mixed with water to mitigate thirst. Decoctions, Liniments, Plasters, Fan, Cold and Hot Water, Iron Pans and other Earthen Vessels; Beddings and Seats, Obedient, Steady and Strong Servants should be kept ready before surgery.

Pradhana Karma (Main Operative procedure):

This includes mainly Ashtavidha Shastra karma [eight surgical procedures- Table-1] and Ayurved surgeon must be familiar with these eight surgical procedures. Almost all surgeries performed today are conducted by modern surgeon with these eight techniques of Sushruta. ^[20]

Suturing:

The threads used may be of silk, cotton, jute, human hair, horse hair, Snayu (tendon), inner bark of tree, tendril etc. ^[21] The needles may be of straight, round body, straight triangular, curved, half curved, curved triangular etc. The types of suturing are:

Rujugranthi (Simple interrupted), *Anuvellita* (Simple continuous), *Gophanika* (Blanket sutures), *Tunna sevani* (Lambart, Subcuticular) etc. ^[22] In surgery how skin suturing should be done to avoid the complication is most important. It should not too long from margin otherwise may be painful and should not be too close from margins otherwise they will cut through (Su. Su. 25/26).

Paschat Karma (Post Operative measures):

After the operative procedure, the patient is to be assured. The operative wound is to be cleaned & dressed with *Vikeshika* (medicine impregnated pad) or proper medicated oil, emulsion, paste or dusting powder etc. ^[23] The operative wound portion is to be fumigated with germicidal and air purifier medicines to avoid the pus formation. The patient is to be kept in *Vranitagara* (Post operative ward) for ten days.

Bandhana (Bandaging):

A detailed account of utilization of bandages in post operative care of the wound and also in fracture management is also noteworthy. ^[24] Medicos were told to learn fourteen varieties of bandaging methods on dummies (Table-2).

Specification of Surgical ward:

Sushruta directs that there should be a particular room provided for patients who have undergone surgical operation. ^[25] This room should be a clean house, situated in a wholesome locality, free from draughts and not exposed to glare of the sun. The bed of the patients should be soft, spacious, and well-arranged. Pastils made of *Sinapis nigra* and *Azadirachta indica* with clarified butter and salt, should be burnt in the room morning and evening for ten days continually. The fumigation of the sick-room with antiseptic preparations such as Ashtanga dhupas is no way inferior to the modern introduction of OT Fumigation.

As regards dispensaries, Sushruta advises the physician to construct his dispensary in a clean locality, and the building should face towards some auspicious direction as the east or the north. The medicines should be kept in burnt earthen pots arranged on planks supported by stakes or pins.

Anaesthetics in Indian System of Medicine:

Many indications showed that earlier surgeons felt the necessity of such an agent to produce insensibility to pain. Sushruta mention the used of wine to produce the desired effect. He says: "After extraction of a dead foetus before the full term, wine should be prescribed to her, for that will improve the condition of her uterus, make her happy and alleviate the pain of the operation." There is no literature on anaesthesia anywhere in the world preceding this practice.

Sushruta says-wine should be used before operation to produce insensibility to pain those having habit of drink wine. He again remarks; it is desirable that the patient should be fed before being operated on those are non-addicted to wine. Those who are addicted to drink and those who cannot bear pain, should be made to drink some strong beverage. ^[26] The patient who has been fed, does not faint, and he who is rendered intoxicated, does not feel the pain of the operation.

Qualities of Surgeon:

Courage, quick handedness, non-shaking, non-sweating, sharp instruments, self confidence and self command are what should be possessed by a surgeon. ^[27] The qualities are alike as Lion's Heart, Eagle's eyes' Ladies finger, etc. as mentioned in modern era.

Importance of written consent:

In case of surgery in *Ashmari* before planning the surgery on urinary bladder Sushruta advised to take prior permission of king before surgery on the patient. ^[28] The surgery mentioned is today's perineal cystostomy which was practicing at that time and may be fatal in some individuals so written consent is need of that time which is relevant to today's surgical ethics and importance of written consent before all surgeries.

Types of incision:

Circular incision is preferred at arm & leg, while semi circular incision at anal region. ^[29] In case of *Bhangdara* (Fistula in ano), *Langlaka* (Curvilinear), *Ardhalanglaka* (half curvilinear), *Gothirthaka* (Longitudinal) etc incisions are described. ^[30]

Plastic and Rhinoplastic operations:

It was proud thing for Ayurvedic community to say that first successful demonstration of plastic surgery was by Sushruta, ^[31] it showed the feasibility of mending a clip earlobe with a patch of sensible skin-flap scraped from the neck or the adjoining part. In *nasa sandhan* (Plastic surgery –Rhinoplasty) excised part of nose is measured & same part is taken from cheek then graft at nose with some part connected for

circulation which helps early healing (Su. Su. 16/50). This contribution made Sushruta the Father of Plastic surgery.

Midwifery:

The application of the forceps in cases of difficult labour and other obstetric operations involving the destruction and mutilation of the child, such as craniotomy, [32] were first systematically described in the Sushruta Samhita long before fillets and forceps were dreamt of in Europe. His direction regarding the management of the puerperal state, lactation and management of the child and the choice of a nurse are substantially the same as are found in modern scientific works of European authors.

Arbuda (Neoplasms /Malignant Lesions):

Literal meaning of *Arbuda* is a lump or a mass or a polyp. According to Sushruta, *Arbuda* are gradually increasing, big, globular, slightly painful, fixed, deep-seated, fleshy masses that usually do not suppurate. [33] They can arise from any part of the body surface. They are caused by derangement of *mamsa* and *rakta* vitiated by *tridosha*. The phenomenon of the spread of tumours or metastasis (*dwirarbuda*) was well known to ancient Hindu physicians and surgeons. Several references are available regarding local and distal spread of the tumour (*dwirarbuda*) as well as its recurrence (*adhyarbuda*). While describing the treatment of tumours, Sushruta mentioned that all efforts should be made for the complete removal of tumours, as incomplete removal causes recurrence and ultimately destroys the person. To explain, the graveness of recurrence, he gave an example that a small remnant tumour can destroy the body just as a small spark of fire can destroy a house. The role of detoxification therapies (*Shodhana* procedures) on cancer patients as pre-therapy to conventional line of treatment showed that these procedures increased body weight, improved serum immunoglobulins, [34] increased haemoglobin levels and normalized liver functions, and also helpful in minimizing the adverse effects of chemotherapeutic agents.

Dagdha (Burns):

The thermal trauma, whether due to extreme cold or heat, wet or dry, [35] chemical or inert fluid, produces damage almost similar and hence has to be managed as one entity. This great value of classification could be realized from the fact that this concept gained validity in modern surgery in recent times.

Bloodletting:

Bloodletting is practicing in western world which is the contribution of great Sushruta. [36] Two separate chapters (*Jalaukavacharan* and *Siravedha*) were devoted for the bloodletting in patients of disorders having vitiation of blood. [37,38] As Sushruta given more importance to the *Rakta* as *dosha* because *Rakta* is main stream of the body so during bloodletting every attempt should be made not to remove more blood as *Rakta* is *pran*. [39] Now a day's plastic surgeons are routinely used *Jalauka* [Leech (*Hirudina medicinalis*)] for the proper acceptance of graft. In case of post trauma hematomas and in ischemic cases leech application was reported very useful by many surgeons. [40,41] A review article on medicinal uses of Leeches was published by USA scientist but in historical review they did not refer to Sushruta or Sushruta Samhita. [42] In this context one of our Ayurved Scholar written to editor of Journal of Postgraduate medicine about the original medicinal uses of Leeches (*Jalaukavacharan*) since Sushruta. [43]

Ophthalmic Surgery:

Among seventy six ophthalmic diseases, fifty one are surgical. The mode of operation which is to be performed in each case has been elaborately described.

Sushruta is attributed the glory of discovering the art of cataract-crouching which was unknown to the surgeons of ancient Greece and Egypt.

Fractures & Dislocations:

The major part of surgery was indeed concerned with trauma and its management. Sushruta has clearly distinguished fractures from dislocations and classified them differently. ^[44] Fractures were known to be associated with swelling, intolerance to touch, severe pain, loss of movement, crepitus and flaccidity of the limbs. The twelve types of fractures included a wide range from greenstick and hairline to compound and comminuted fractures while six numbers of dislocations were also described. The basic manipulations recommended for treating fractures and dislocations are *Anchana* (Traction), *Pidana* (Compression), *Samskespha* (immobilisation) and *Bandhana* (bandaging) is nowhere less than the contemporary orthopaedic practice. The application of medicinal plasters using herbs like *Vata* (*Ficus bengalensis* Linn.), *Udumbara* (*Ficus glomerata* Roxb.), *Ashwattha* (*Ficus religiosa* Linn.), *Palasha* (*Ficus lacor* Buch-Ham.) etc were advocated. In compound fractures local treatment of wound was specified and many formulations cleansing and for the promotion of healing is recommended. Appropriate diet for the patient is suggested in order to heal the fracture early. Sushruta's approach to the treatment of fractures and dislocations was rational, practical and even radical because he was not averse to breaking a neglected and malunited fracture and resetting it.

Lithotomic operations:

The surgical procedure (Shastra Karma) depicted in Ashmari Chikitsa (Management of Vesical /Renal calculus). ^[45] First, the patient should be cleansed of the vitiated dosas. Then the patient, who is strong enough and is not nervous, should be laid flat with upper part of his body resting on the lap of another person sitting on a knee-high plank facing east; the patients' waist should be raised by cushions and his knees and ankles flexed and tied together by straps (lithotomy position). After massaging the left side of the well oiled umbilical region pressure should be applied first below the navel until the stone comes down. Introduce the lubricated index and middle fingers into the rectum below the perineal raphe. Thereafter, with manipulation and force bring the stone down between the rectum and the penis. Keeping the bladder tense and distended so as to obliterate the folds, the stone is pressed hard by fingers so that it becomes prominent like a tumour.

An incision of about the size of the stone is then made just a few millimetres away from the perineal raphe on the left side. Some surgeons prefer the incision on the right side for the sake of technical convenience. Precautions should be taken so that the stone does not get broken or crushed. Even a small particle left behind can increase in size. The stone is then removed with an agravaktra instrument (small-tipped forceps, like mosquito forceps). The operation, perineal cystolithotomy which Sushruta described was performed in ancient times in Arabian countries as well as Europe and was known as 'cutting for stone.' ^[46]

Glimpses of ancient surgical practices:

Surgery was advised by Sushruta at the ancient time which is practicing today in following diseases which are quoted with classical references. *Jalodar* (Ascitis), *Mutravrudhi* (vaginal Hydrocele), *Baddhagudodar* (Intestinal obstruction), *Cchidrodar* (Intestinal perforation), *Arsha* (Hemorrhoids), *Bhangandar* (Fistula-in-Ano), *Mudhagarbha* (IUD-intrauterine death) and *Kaphaj-lingnas* (Cataract).

In *Jalodar* (Ascitis) *vedhan karm* i.e. tapping is to be performed. *Vedhan* is done in abdomen below & left lateral to umbilicus with the help of trocher & canula for removing some fluid (Su. Su. 25/10 and Su. Ch. 14/18). *Vedhan karm* i.e. tapping of

fluid collected in tunica vaginalis layer was advised in **Mutraj-vradhi (Vaginal hydrocele)**. The site of tapping is lateral side of *sevani* of scrotum to avoid injury to testis & then remove the fluid with the help of *vrihimukh nadiyantra* (trocher and canula). (Su. Ch. 19/19).

In **baddha-gudodar (Intestinal obstruction)** incision should be taken like left paramedian (four angul apart from midline) then open peritonium and remove obstruction as possible; lastly see four *angul* intestine from obstruction site & kept all intestine in abdomen as it is. Then *udar sivan* (abdomen closer) is to be done (Su. Ch. 14/17). In **chhidrodar (Intestinal perforation)** application of *pipilika* (big ants) should be done in the perforated part of intestine is resemble today's advanced staple method for intestinal suturing. Then Sushruta told to close the abdomen layer wise (Su. Ch. 14/17).

In **Arsha (Haemorrhoids) shastra-karma** i.e excision of piles was described by Sushruta in pedunculated, broad & bleeding piles. That means haemorrhoidectomy was performed in ancient time (Su. Ch. 6/3). In **Bhangadar (Fistula - in- Ano)** after probing in fistula tract it should be elevated & total tract is removed i.e. fistulectomy was practiced during Sushruta's time. Sushruta also stated to do *Ksharsutra* in child, old and female patients as these patients are comparatively weak (Su. Ch. 17/29).

In **Mudhagarbha** i.e. in case of intra uterine death (**IUD**) to survive mother Sushruta advised to remove dead part of foetus which can be correlate with removal of dead foetus i.e. craniotomy (Su. Ch. 15/11).

In **kaphaj linganasha (Cataract)** the incision is taken not below, not above, not laterally i.e. exactly at *daivyakrita cchidra* (limbal region) which is today's cataract-crouching (Sushruta Ut. 17/59).

References:

1. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthan, Chapter-15 Verse-41), Chaukhambha Sanskrita Sansthan, Varanasi, India.
2. William h. Donner (2008), bedroe's origin of the healing art and sir john lubbock's prehistoric times. University of Toronto library.
3. Albercht Weber (1892), Weber's History of Indian Literature. Cornell University Library.
4. Bhaskaracharya, Siddhanta Shiromani; Goladhyaya.
<http://veda.wikidot.com/bhaskaracharya>
5. Kunjalal K.B. (1916) The Sushruta Samhita - An English Translation Based on Original Texts. <http://chestofbooks.com/health/india/Sushruta-Samhita/index.html#ixzz1qZmND8mY>.
6. Terence M. Davidson M.D. (1977) The source book of plastic surgery Edited by Frank McDowell, , Illus, Williams & Wilkins, Baltimore. Pp.509
<http://onlinelibrary.wiley.com/doi/10.1002/hed.2890010313/abstract>
7. Bhattacharya S. (2009) Sushruta - our proud heritage. Indian Journal of Plastic Surgery. 42(2), pp.223-225.
8. Rimmer Y. Maugham S. (2009) A doctor in human bondage. Harefuah.148 (6), pp.402-403.
9. Swinton W.E. (1976) Physicians in literature: Part IV: Somerset Maugham, talented but troubled. CMA JOURNAL. 114 (10), pp.61-67.
10. Shastri A. (2001) Sushruta Samhita, Part-I (Shareer Sthan, Chapter-4 Verse-49), Chaukhambha Sanskrita Sansthan, Varanasi, India
11. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-7 Verse-4), Chaukhambha Sanskrita Sansthan, Varanasi, India

12. Bhattacharya S. (2009) Sushruta-Our proud heritage. Indian journal of Plast Surgery. 42 (2), pp.223-225. <http://www.ijps.org>
13. Shastri A. (2001) Sushruta Samhita, Part-I (Chikitsa Sthana Chapter-2 Verse-46), Chaukhambha Sanskrita Sansthan, Varanasi, India
14. Dr. Tripathi B. Sharangadahara Samhita. Uttarkhanda Chapter-9 Verse 22-24) Choukhambha Subharati Prakashan, Varanasi. India.
15. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-5 Verse-18), Chaukhambha Sanskrita Sansthan, Varanasi, India
16. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-10 Verse-3), Chaukhambha Sanskrita Sansthan, Varanasi, India
17. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-9 Verse-4), Chaukhambha Sanskrita Sansthan, Varanasi, India
18. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-5 Verse-3), Chaukhambha Sanskrita Sansthan, Varanasi, India
19. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-5 Verse-6-7), Chaukhambha Sanskrita Sansthan, Varanasi, India
20. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-25 Verse-1-16), Chaukhambha Sanskrita Sansthan, Varanasi, India
21. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-25 Verse-21), Chaukhambha Sanskrita Sansthan, Varanasi, India
22. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-25 Verse-22), Chaukhambha Sanskrita Sansthan, Varanasi, India
23. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-25 Verse-27), Chaukhambha Sanskrita Sansthan, Varanasi, India
24. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-18 Verse-17), Chaukhambha Sanskrita Sansthan, Varanasi, India
25. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-19 Verse-3), Chaukhambha Sanskrita Sansthan, Varanasi, India
26. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-17 Verse-11), Chaukhambha Sanskrita Sansthan, Varanasi, India
27. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-5 Verse-10.), Chaukhambha Sanskrita Sansthan, Varanasi, India
28. Shastri A. (2001) Sushruta Samhita, Part-I (Chikitsa Sthana Chapter-7 Verse-29), Chaukhambha Sanskrita Sansthan, Varanasi, India
29. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-5 Verse-14), Chaukhambha Sanskrita Sansthan, Varanasi, India
30. Shastri A. (2001) Sushruta Samhita, Part-I (Chikitsa Sthana Chapter-8 Verse-10), Chaukhambha Sanskrita Sansthan, Varanasi, India
31. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-16 Verse-14), Chaukhambha Sanskrita Sansthan, Varanasi, India
32. Shastri A. (2001) Sushruta Samhita, Part-I (Chikitsa Sthana Chapter-15 Verse-12-19), Chaukhambha Sanskrita Sansthan, Varanasi, India
33. Mishra L.C. (2004) Scientific Basis for Ayurvedic Therapies. CRC Press. pp.275-276
34. Parmar R.K. (1983) Comparative study of Ayurveda in relation to Neoplastic Lesions and its management by Indigenous Drugs, M.D. thesis in Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi (UP), India.
35. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-12 Verse-38-39), Chaukhambha Sanskrita Sansthan, Varanasi, India

36. Spencer W.G. Discussion on blood-letting. Blood-letting-it's past and present use. Proceedings of the royal society of medicine. 1927; 20(10): Pp.1547-1574.
37. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-13 Verse-3), Chaukhambha Sanskrita Sansthan, Varanasi, India
38. Shastri A. (2001) Sushruta Samhita, Part-I (Shareer Sthana Chapter-8 Verse-3), Chaukhambha Sanskrita Sansthan, Varanasi, India
39. Shastri A. (2001) Sushruta Samhita, Part-I (Sutra Sthana Chapter-14 Verse-44), Chaukhambha Sanskrita Sansthan, Varanasi, India
40. Menage MJ, Wright G. (1991) Use of leeches in a case of severe periorbital Haematoma. British journal of Ophthalmology. 75, pp. 755-756
41. Townley D, Ramkumar K. (2006) Forgotten digital tourniquet: salvage of an ischemic Finger by application of medicinal leeches. Ann R Coll Surg Engl. 88, Pp. 462-464
42. Porshinsky BS, Saha S, Grossman MD, Beery PR, Stawicki SPA. (2011) Clinical uses of the medicinal leech: A practical review. Journal of Postgraduate Medicine. 57(1), pp.65-71
43. Sathish HS, Vaghela DB. (2011) Blood Letting - An Ayurvedic prespective. Journal of Postgraduate Medicine. 57(3), pp.253-253
44. Shastri A. (2001) Sushruta Samhita, Part-I (Chikitsa Sthana Chapter-3 Verse-44), Chaukhambha Sanskrita Sansthan, Varanasi, India
45. Shastri A. (2001) Sushruta Samhita, Part-I (Chikitsa Sthana Chapter-7 Verse-31), Chaukhambha Sanskrita Sansthan, Varanasi, India
46. Valiathan M.S. (2009) The Legacy of Sushruta. Universities Press, Hyderabad. P.15

Tables:

Table 1 Ashtavidha Shastra karma - Eight surgical procedures:

Sr. no.	Ashtavidha Shastra karma	Eight surgical procedures
1	<i>Chedana</i>	Incision, Amputation or Excision
2	<i>Bhedana</i>	Incision for opening a cavity or Taping of cavity
3	<i>Lekhana</i>	Scraping
4	<i>Vyadhana</i>	Paracentesis or Puncturing
5	<i>Eshana</i>	Probing
6	<i>Aharana</i>	Extraction
7	<i>Visravana</i>	Bloodletting or drainage of pus
8	<i>Seevana</i>	Suturing

Table 2 Fourteen types of bandages:

Sr. no.	Bandhana / Bandage	Utility
1	<i>Kosha</i> (Sheath)	Around thumb and fingers
2	<i>Dama</i> (Long roll)	Sling around straight parts of small width
3	<i>Svastika</i> (Cross- like)	Spica around joints
4	<i>Anuvellita</i> (Spiral)	Around upper and lower limbs
5	<i>Mutoli</i> (Winding)	Circular – around neck, penis

6	<i>Mandala</i> (Ring)	Circular – around stumps
7	<i>Sthagika</i> (Betel box type)	Amputation stumps, tips of penis or fingers
8	<i>Yamaka</i> (Two- tailed)	Around limbs to treat ulcers
9	<i>Khatva</i> (Four- tailed)	For jaw, cheeks, temples
10	<i>Cheena</i> (Ribbon-like)	Outer angles of eyes - temples
11	<i>Vibandha</i> (Loosely knotted noose like)	Over back, abdomen and chest
12	<i>Vitana</i> (Canopy-like)	Protective cover over head wound
13	<i>Gophna</i> (Cow-horn)	Over chin, nose, lips, anorectal region
14	<i>Panchangi</i> (Five-tailed)	Head and neck above the level of clavicles