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EVOLUTION OF SURGERY- *śuśṛta's* INNOVATIVE SKILLS

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ABSTRACT

Surgery and Medicine are inseparably fused today as essential parts of the art of heeling. Over the millennia of recorded history, Medicine and Surgery have followed separate and largely independent evolutionary pertains. It is obvious that medical care could not have been complete without some surgery in ancient times. This branch of medical skill was not accepted as profession. The practitioners were members of all low caste, who were illiterates and passed on their knowledge by oral tradition rather than in writing. The barbers are celebrity surgeons in ancient India and continued till the recent past it is evident by Pandyan inscriptions of Tamilnadu of 7th-8th centuries A.D. The barbers were also the surgeons in ancient and medieval Europe.

śuśṛta, a great ancient Indian Surgeon, who is regarded as father of the surgery, designed surgical equipment with innovative vision and described many surgical procedures, which laid basis for many advanced technologies in this field.

Introduction

śuśṛta (600 B.C) a great ancient Indian Surgeon, who is regarded as " father of the surgery" of the world and whose mastery work '*śuśṛta Saṁhita*' was written before 700 B.C. The development of Indian surgery reached its acme and considers foremost branch of the entire healing art –the *Aṣṭāṅgāyurvēda*. It is evident that surgery achieved considerable mastery in diagnosis, operative intervention and after treatment. The Surgical and parasurgical procedures are rationally and intelligently described.

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The most outstanding achievement of Indian Surgery is described vividly on Lithotomy, Laporotomy, and Plastic Surgery. The practice of piercing custom of ear & nose and punishing many even slight offences by the amputation of Nose and Ears during ancient times. All though the question of reciprocal influences of Indian and Western medicine in general has never been completely answered, it is an established fact that Indian plastic surgery provided the Basic pattern for western efforts in this direction. The *"śalyatantra"* the science in which *'śala'* (surgical instruments) are used and *'tantra'* means science (Amara Kosa II. 5.7) or the science which mainly deals with the techniques to remove the *'śalya'* substances which penetrate the body easily, to cause injuries and produce pain. The word *'śala'* and *'śalya'* have been derived from the verbal root *'śal'* means to enter easily, to cause injury and to cause pain. *śalya*, the Arrow, which is most important weapon used in ancient Indian Warfare. Surgery advanced through care of wounds sustained in battle or by other means.

Vesalius Andreas (1514-1564 A. D.), the Belgian physician, whose innovations revolutionized anatomy, to make use of illustrations in teaching anatomy and then surgery), dismissed the barber surgeons and taking the knife in hand, performed postmortem dissections himself, at the same time lecturing to the assembled students in spite of the unpleasant stench. To lessen the stench dissections were usually held in the open air; even stench was unbearable and situation extremely strenuous for both students and lecturers. Due to this, winter was preferred for dissection classes, as bodies don't get rot in the freezing cold.

The earliest conception of surgery was that diseases of an external nature were suitable for treatment by manual operations, as opposed to internal conditions were treated by drugs, etc. The word '*Cheirurgeon'* (presently spelled as surgeon), derived from Greek –means *'Cheiru'*-the hand and *'ergeon*' -the work[5]. Thus one, who works with his hands, an operator, is called as *Cheirurgeon.* It has been in English since the 14th century. For a long time there was no distinction between the barbers and the surgeons. In 1745 giving individual charters separated barbers and surgeons of London. The surgeon's charter was renewed in 1800 as the Royal College of Surgeons of London, and again in 1843 when the company of surgeons was named 'The Royal College of

Surgeons of England' The name Royal College of Surgeons had been conferred earlier in Scotland (1778) and Ireland (1786)[7].

Cheirurgia (Surgery), is derived from Greek as *Cheir*-means hand and *ergia*-means work, that the branch of medicine which treats diseases, injuries and deformities by manual of operative methods.

VICISSITUDE OF MEDICINE AND SURGERY

Medicine and Surgery, though parts of the Medical Science are treated as distinct branches. According to Indian mythology, there are two schools of medical science such as the *Atreya School* primarily deals with medicine and the *Dhanwantari School* deals with surgery.

According to *ātrēya* school of medicine, *āyurvēda* was first, perceived by Brahma and he taught this science of life to *Dakṣaprajāpati*, who taught it to *Aśvani Kumārasa* and they taught it to *Indra*. On be half of *Angiras, Vaśiṣṭa, Kāśyapa, Bhṛgu, ātrēya* etc. most eminent sages, *Bharadvāja* approached Lord *Indra* and learnt medicine in the form of three aphorisms containing the knowledge of the *Hetu* (cause), *Linga* (symptoms) and *Auṣadha* (remedies) of diseases. Then he taught to *ātrēya Punarvasu*. He taught *āyurvēda* to his six disciples namely *Agnivēṣa, Bhēla, Jaṭhukarṇa, Paraśara, Harita* and *Kṣārapaṇi.* These disciples on the basis of their own understanding of the subject, composed treatises and were recited before the assembly of seers headed by *ātrēya Punarvasu*, they agreed that all the books had been duly compiled.

According to *Dhanwantari School of surgery*, Lord *Dhanwantari* learnt from *Indra*. Then he taught to *śuśṛta, Aupādhēnava, Aurābhra, Pauṣkalavata, Gōpurakṣita* and *Bhōja* in the form of *śalya tantra* and other divisions of the *āyurvēda* in a comprehensive way.

Just as *Brahma* revealed *āyurvēda* to the Indians, so did Thoth and Apollo revealed the Egyptian and Greek system of medicine.

The Hindu Medicine or ancient Indian Medicine attained the pinnacle of its glory not only in the present era (*Yuga*) but also during the period of *Rāmāyaṇa* and

Mahābhārata. *Suśēna* was the principal army surgeon of *Rāma* in his war with *Rāvaṇa*, the King of Lanka, and *Vālmīki*, writer of the famous epic *Rāmāyaṇa*, makes mention of a particular *Vaidya*, who was *Rāma's* personal physician. A similar practice is noticed during the time of '*Mahābhārata*' the Great War between the *Pāṇḍava* and the *Kauravas*. The army surgeons were fully equipped with the necessary medical and surgical appliances (Mahabharat, Bhismaparva, Ch.120). *Duryōdhana*, the eldest of the *Kurus*, when pierced with arrows, was made by his surgeons to sit in a tub filled with medicated water, under which he was freed from the missiles lodged in his flesh. Both the conflicting armies had distinguished surgeons on their staff. Veterinary science seems to have been highly cultivated long before that period.

The King *Nala*, a remote ancestor of the *Pāṇḍava*, is described as a most accomplished horse-trainer, and had possessed a thorough knowledge of all matters relating to the horse. *Nakula*, one of the five *Pāṇḍava*, was an expert in the veterinary science on which he has written several works, his *"Asva-cikitsa"* being still extant. The science of treating elephants, bullocks and other domestic animals, was and is still known in India. Some are of opinion that *Vāgbhaṭṭa*, the celebrated author of *"Aṣṭāṅgahṛdaya"*, flourished at the time of the *Mahābhārata*, and that he was the family physician of the *Pāṇḍava*.

The court of every King/ruler/chief (great or small) was attached with Physicians & Army Surgeons, who were treated with great respect and use to confer with titles like '*Vaidyō Nārāyaṇō Hari*' (on par with god). The Court physician used to wait upon the king every morning, as the custodian of his health and Army surgeon has to attend the sick/injured soldiers and horses/elephants, which is similar to that performed by the army surgeon of the present day.

During the time of *Buddha* (543 B.C.) Indian medicine received the greatest support and stimulus, *Buddha* and his followers would not permit the dissection of animals, animal sacrifice, in which knowledge of anatomy was indispensable, and substituted by models of dough, and surgery was allowed to languish. Buddha, established hospitals for men and beasts all over the country.

The science continued to flourish down to the advent of the Greeks in India (327 B.C.). Arrian, the Greek historian, in describing the condition of India at the time of the invasion of Alexander the Great refers to a curious fact, which reflects no small credit on the Hindu physicians of the day. Alexander had in his train several proficient Greek physicians, who confessed their inability to deal with cases of snakebite, very common in the Punjaub. Alexander was therefore obliged to consult the Indian Vaidyas, who successfully treated these cases. The Macedonian king was so struck with their skill that, according to Nearchus, he employed some good Vaidyas in his camp, and desired his followers to consult these Indian physicians in cases of snakebite and other dangerous ailments. In face of the fact that the European toxicologists are still in search of a specific treatment for snake- poison, the Indian Physicians who lived some 2200 years ago might well be proud of their skill. It is very likely that on his homeward march Alexander (Sikander) as he is called in India, took with him a few professors of Hindu medicine. This supposition receives some support from the early history of Greek medicine.

There is a great similarity between the origins of the Greek and Indian medicine. Both the systems claim to be divinely inspired. The divine physicians *Aśvini*, the twin sons of the Sun, bear a close analogy to the divine twins Apollo and Artemis, who cured and alleviated the sufferings of mortals, and who derived their birth from Zeus, or the "God of Light".

Hippocrates, the most celebrated physician of ancient Europe (460 B.C.), believed the art of medicine to be the production of the Divine Being; and it is curious to note that the Greeks, the Indians, and all the ancient nations of the world, have ascribed all kinds of knowledge, including the mysteries of life, disease, and death, to a superhuman agency. In the opinion of some writers, Hippocrates acquired his knowledge of medicine in India or acquainted with Indian Medicine. Plato and Hippocrates both believed in humoral pathology, and taught their pupils that the diseases in the body were caused by four humours, blood, bile, phlegm, and water. The fact, however, that the three humours of the body are referred to in the *ṛagvēda* (2500 B.C) the first literary record of India, may even of the whole world is a repository of 1098 hymns (mantras) extolling the

deities of many natural phenomena. (i.34, 6), establishes the priority of the Indian system beyond all doubt. The Greek physician Galen (130-200 A. D.), whose thinking dominated western medicine for about 1500 years said to be adopted some of the fundamental principles of the Hindu medicine and it is through some of his works.

Professor Weber, asserts in his History of Indian Literature that " there is no ground whatever to suppose that Susruta borrowed his system of medicine from the Greeks; on the contrary, there is much to tell against such an idea." The Indian books on medicine do not contain any technical terms, which point to a foreign origin. Dr. Hirschberg of Berlin, in a learned paper, adds, with regard to certain surgical operations, "the Indians knew and practiced ingenious operations, which always remained unknown to the Greeks, and which even Europeans only learnt from them with surprise in the beginning of this century." Professor Diaz of the Koningsberg University clearly detects the principles of Indian medicine in the Greek system. Even those who talk eloquently of the antiquity of Greece withhold from the credit of originality with regard to medical science, and opine that the Greek were indebted to Egypt for their knowledge of medicine.

The great works of *Caraka* and *śuśṛta* were translated into Arabic, under the patronage of Khalif Almansur, in the 7thcentury. The Arabic version of *śuśṛta* is known by the name of "Kelale-Shawshoor-al-Hindi." these translations, in their turn, were rendered into Latin. The Latin versions formed the basis of European medicine, which remained indebted to the eastern medicine down to 17th century.

There was no period in the History of Indian literature and science in which so liberal a patronage was given to learning in general, to poetry and medicine in particular, as in the reign of King *Bhōja* of Dhar (977 A.C.), which was a golden age of Hindu literature. The King himself was a learned man, reputed author of a treatise on medicine and other works. Pandit Ballala, in his *Bhōjaprabandha*, or a collection of literary anecdotes relating to King Bhoja, describes an interesting surgical operation performed on the king Bhoja, who was suffering from severe pain in the head. He tried all medicinal means, but in vain and his condition became most critical, when two brother physicians happened to arrive in Dhar, who, after carefully considering the case, came to the conclusion that the patient would obtain no relief until surgically treated. They accordingly administered

a drug called *Sammōhini* (kind of Anesthetic drug) to render him unconscious when the patient was completely under the influence of the drug, they trephine his skull, removed from the brain the real cause of complaint, closed the opening, stitched the wound, applied a healing balm and then administered a restorative medicine called *Sañjīvini* to the patient, who thereby regained consciousness, and experienced complete relief. **(photo)** This incident clearly shows that the Indians knew brain-surgery, which is considered one of the greatest achievements of modern science. This is not a solitary instance *Jīvaka*, the personal physician of Buddha, is recorded to have practiced cranial surgery and abdominal section with the greatest success **(photo).** Thus the ancient Hindu surgeons performed operations regarded as "triumphs of modern surgery"[1].

SUSRUTA'S CONTRIBUTION TO THE WORLD SURGERY

Susruta classifies surgical operations[8] as follows viz.

1. *Bhēdya*- Excision
2. *Chēdya*-Incision
3. *Lēkhya*- Scrapification
4. *Vēdhya*- Puncture
5. *ēsya*- Probing
6. *āhārya*- Extraction
7. *Viśravya*- Evacuation of fluids
8. *sīvya*- Suturing

śuśṛta has recognized and emphasized the importance of practicing the surgery on objects other than human beings[9]. He has described the importance of experimental surgery to obtain complete success in the aimed operating procedure surgeon should practice the surgery methodically on such objects to have presence of mind while doing the actual surgery.

Experiments of Excision

The different experiments of excision should be demonstrated on pumpkin-gourd, bottle gourd, watermelon, cucumber, *eravarukaand karkaruka.* Excisions in the upward as well as downward directions should also be instructed upon these.

Experiments of Incision

The experiments of incision should be demonstrated on leathern bag, urinary bladder (of an animal) and leathern bottle, etc. full of water and slime.

Experiments of scraping and puncturing

The (experiments of) scraping (should be demonstrated) on a piece of hairy skin spend out and those of puncturing on the vessels of dead animals and on the lotus stalks.

Experiments of Probing and Extraction

The experiments of probing should be demonstrated on moth eaten wood, bamboos, reed-tubes and mouth of a dried gourd; and those of extraction on jackfruit, *Bimbi* the pulp of *Bilva* fruit and on the teeth of dead animals.

Experiments of Drainage and Suturing

The drainage should be demonstrated on a piece of *śālmali* wood coated with beeswax and suturing on the borders of fine, closely knitted clothes and on the borders of soft leather.

Demonstration of Bandaging

The bandaging should be demonstrated on different parts and subdivisions on the dummies made of cloth.

Experiments of Cautery and Caustics

The experiments on the use of cautery and caustics should be demonstrated on soft muscle pieces.

Plastic surgery of ear should be demonstrated on soft leather, muscle bellies and lotus stalks.

Miscellaneous Experiments

The experiments of application of nozzles of enema apparatus and the wound irrigation should be demonstrated on the side hole of an earthen pot full of water and on the mouth of a gourd.

For example, an abscess was either made to subside by certain kinds of plaster

or the swelling was assisted to mature by means of poultices, and when ripe was opened, not always with the knife, but by the application of a mixture of *Danti, Citraka, Eranda* etc drugs. Cases of urinary calculi were treated with antilithics and diuretics were administered so as to act as solvents for the stone[2].

It may as well be added that they were perfectly acquainted with the anatomy of the goat, sheep, horse, and other animals used in their sacrifices. Early warfare was conducted with such weapons as bow and arrow, sword, mace, etc. Thus in every war the services of bold and skilful surgeons were always in requisition for extracting arrows, amputating limbs, arresting hemorrhage, and dressing wounds. Susruta gives very minute directions to be observed in the performance of surgical operations, and describes the method of opening abscesses, treating inflammations, boils, tumors ulcers and fistulae, and of applying blisters, cautery, etc. The constant wars and squabbling afforded ample opportunities to the surgeons to distinguish themselves in their profession and acquire considerable dexterity in their work. A glance at the Vedic or the Epic period will bear testimony to this fact. The surgeons of the period are recorded to have performed incredible feats in surgical operations, just as modern surgery is able to do many things, which ordinary folks will hardly believe to be possible. In its onward progress, modern surgery may yet be able to succeed in doing what the ancients claim to have performed[3].

The surgeon, before commencing an operation, is enjoined to equip himself with all the requisites, such as the instruments, salts, bandages, honey, oil, water, etc. have by his side steady and strong attendants to assist him. He should be intelligent, steady, and skilful and execute his work with a light hand and have practical experience of his art, by witnessing surgical operations performed by others. The patient should be allowed to take light food before any operation is performed upon him. Abdominal operations, however, and operations in the mouth, or about the anus, should be performed when the patient is fasting. The operation should be performed with the utmost care; and after it is over, a sesamum poultice should be applied on the wound, and a cloth bandage be tied around it. A certain incense should be kept burning in the operation room. (This foreshadows the germ theory of the present day.) The surgeon should not

leave his patient without offering a prayer to the almighty for his speedy recovery. Particular attention is to be paid to the regimen of the patient. The wound must be dressed at regular intervals until it is all healed up. If the wound causes intense pain, a cloth soaked in tepid ghee (clarified butter) mixed with liquorices may be applied to it[4].

HIS INNOVATIVE SURGICAL EQUIPMENT

The Indian surgery recognized the following surgical equipment and broadly grouped under two heads –blunt are called *Yantras* (appliances) and sharp are called as *śāstras* (instruments)[6].

1. THE YANTRAS (APPLIANCES):

These instruments were used for the removal of *salyas* (foreign bodies), which produced disorders either in the mind or in the body. The total of 101 blunt instruments have been described and divided into the following six groups. The *Hasta* (hand) has been considered as the most important single instrument, which is rightly considered to be the best and most indispensable implement in surgical operations. For specimens of some of the implements used in Indian surgery.

1. *Svastikas*-Cruciform forceps (24 varieties)
2. *śandāmaśas*-Pincers like forceps (2 varieties)
3. *Tāḷas*- Pick lock like (2 varieties)
4. *Nāḍiśa*-tubular instruments like catheters, Cannula etc., (20 varieties)
5. *Salakṣa*- bougie like Probes and Sounds (28 varieties)
6. *Upāyantras*-Accessory instruments like dressings, as clothe, twine, etc., (25 varieties).

The Swastika Yantras–Cruciform Instruments

The word swastika is a technical term signifying one of the 24 signs of the Jinas and it can be represented by two lines crossing each other the arms of the cross being bent at their extremities towards the same direction. These instruments may be described as cruciform. It should be of 18 fingers breadth in length and the front should be the shape of the mouth of ferocious animals and birds and are to be called after their names. The *Swastika yantras* are used for extraction of foreign bodies impacted in the bones. They are divided into two classes:

Class I resembles the mouths of *Simha* (lion) and *Vyāghra* (tiger)

If the foreign body is visible, the Lion forceps or similar forceps can be used to extract it.

1. *Simhamukha Svasthika* (lion-faced forceps)-designed by nature to catch their prey firmly, eg. Ferguson's Lion jaw bone-holding forceps.
2. *Vyāghramukha* (Tiger forceps)- A bone gnawing forceps with double jointed.
3. *Vṛkamukha* (Wolf forceps). Ferguson' bone-holding forceps
4. *Tārākṣmukha* (Hyena forceps)-Farabeuf's forceps
5. *Rkṣamukha* (Bear forceps)- Bulldog forceps
6. *Dwipimukha* (Panther forceps)- Gross's bullet forceps
7. *Marjaramukha* (cat forceps)- Mouse tooth forceps
8. *Sṛgalmukha* (Jackal forceps)- Bone forceps
9. *Airvāruka* (Deer forceps)- Bullet forceps

Class II comprises of the faces of birds of prey

If foreign body is invisible, the Kankamukha (Heron forceps) or similar forceps will be the ideal to extract it. Out of which, the Heron forceps is the best since it can be easily introduced and turned in all directions, and also it grasps firmly and extracts a foreign body with ease and can be applied without any harm to all parts of the body.

1. *Kākāmukha* (Crow forceps)
2. Kānkamukha (Heron forceps)
3. *Kuraramukha* (Osprey forceps)
4. *Casamukha* (Blue-jay forceps)
5. *Bhasamukha* (Eagle forceps)
6. *śaśaghāṭimukha* (Hawk forceps)
7. *Ulukamukha* (Owl forceps)
8. *Cillimukha* (Kite forceps)
9. *śyenamukha* (Vulture forceps)
10. *Grdhramukha* (Falcon forceps)
11. *Krauncamukha* (Ardea jaculator/Curlew)
12. *Bhṛṅgarājamukha* (Fork tailed/Butcher bird forceps)

13. *Añjalikarṇamukha* (birds not identified)
14. *Avabhāñjanamukha* (birds not identified)
15. *Nandimukhāmukha* (not identified)

The *śandaṁśa* Yantras– Pincher like forceps

The *śandaṁśa*– comprises only two instruments: the forceps *śanigraha* (with arms*)* used by the barbers for depilating the nasal cavities, consists of two arms joined crosswise by a pin fixed at about their middle points, and so really is a cruciform but is classed here for its different use in surgery. The forceps *Anigraha* (without handles*)* like the armless forceps used by the goldsmiths. The forceps without handles consists of two blades soldered at one end. Some commentators like to subdivide the pinchers into two classes according as their ends are rough or smooth. Hessler translates: "Duae forcipes denticulate et non denticulate".

The *Sandaṁśa* are used for the purpose of extracting foreign substances from the soft structures of the human body, such as the skin, muscles, veins, nerves, and tendons. Generally they have a length of *Sōḍaśa Aṅguḷi* (16 inches).

The Tala Yantra- Picklock like Instruments

The *Tāḷa Yantra* has a length of *Dvādaśa Aṅguḷi* (12 inches) and are shaped like the jaws of a fish. They may be made either with an *ēkatāḷa* (single blade) or with *Dvitāḷa* (double blades) soldered at one end, the hooked ends being free. They are intended for the purpose of extracting foreign bodies from the ear, nose and other outer canals of the body. The ear scoop now used by the barbers of India for extracting wax from the ear is a *Tāḷayantra.*

***Nāḍi* Yantra-Tubular Instruments**

The *Nāḍi* or tubular instruments are of various kinds to serve many purposes. They are open either at one or both ends. These are used for the extraction of foreign substances from the natural outlets of the body. They are recommended to be use as a diagnostic apparatus for inspection of diseases in the canals. They are the means of sucking out fluid discharges, as pus etc. from cavities and they facilitate the performances of other operations. They vary in length and diameter in proportion to the different sizes of the outer canals of the body, or according to the varieties of purposes to be served by them.

The tubular instruments are used for fistula-in-ano, hemorrhoids, tumors, abscesses, injections into the rectum, vagina and urethra, hydrocele, ascites, inhalations, stricture of urethra and rectum and cupping as by gourd and horns.

1. *Bhagandar* yantra I – Rectal speculum with one slit used in fistula in Ano.
2. *Bhagandar* yantra II - Rectal speculum with two slits used in fistula in ano.
3. *Arśasō* yantra I-Rectal speculum with one slit used in piles.
4. *Arśasō* yantra II-Rectal speculum with two slits used in piles.
5. *Vraṇa Nāḍi Yantra*– wound- Irrigator or syringe.
6. *Vāsti yantra* I–Rectal clysters or enema nasal Used for up to1year old children, 6 inches in length-little finger circumference.
7. *Vaāti yantra* II- used for 1-8 years old children, 8 angulas in length-Ring finger circumference.
8. *Vāsti yantra* III- used for 8-16 years old children& 70 years and above- 16 angulas in length-Middle finger circumference.
9. *Vāsti yantra* IV-Used for 16-50 years old children - 12 angulas in length Thumb finger circumference.
10. *Uttaravastiyantra* I–for female
11. *Uttaravāstiyantra* II -for male
12. *Mūtra Vṛddhi Nāḍi yantra*- canula used in hydrocele
13. *Udakōdara Nāḍi* yantra –canula used in Ascites
14. *Dhūmapānayantra* I-inhalers or respirators used in *virecaka Dhoomapana*
15. *Dhūmapānayantra* II- used in *snehana Dhoomapana*
16. *Dhūmapānayantra* III -used in *prayogika Dhoomapana*
17. *Niruddha Prakāśayantra* – dilator used in urethral stricture
18. *śanivṛddha gudayantra* – rectal dilator used in rectal stricture
19. *Alabu yantra*– bottle-guard used in blood letting
20. *śṛṅga yantra* – hollow Horne- used in blood letting

The Sālaka Yantras– Rod Shaped Instruments

The rods, or pricker-like instruments, or probes are described to be of various kinds and are recommended to be used for various purposes; so their length and

circumference would vary according to some special uses required of them. Some of the simple probes used by the ancient Greek and Roman surgeons carried a single or double snake of Aesculapius at one end. But evidently it was meant as ornamentation and served no useful purpose.

1. *Gaṇḍupādamukha* (like Earth-worm's mouth) – Blunt probes (2 varieties) used in probing.
2. *Sarpa phanamukha* (Snake 's hood like) - Retractors (2 varieties) used in retraction.
3. *Sarapunkhamukha* (Arrow-stem like) – Hooks (2 varieties)-used in separation.
4. *Vaḍiśamukha* (Fish-hook like) - Hooks (2 varieties)-used in extraction.
5. *Māśuradalamukha* (like *Masura* pulse) – (2 varieties) used for the removal of foreign bodies located in external channels.
6. *Pramarjana* (Swabs probes) – (6 varieties) caped by cotton and used in swabbing.
7. *Khallamukha* (Spoon like probes) – (3 varieties) used for applying *ksara* (caustics) and other medicines.
8. *Jamvavavadana* (black berry seed like cautery rods) – (3 varieties) used in *Agnikarma* (cauterization).
9. *Aṅkuśavadana* (Goad like)-(3 varieties) used in *Agnikarma* (cauterization).
10. *Kōlāsthidaḷamukha* (Plum seed like Nasal Curatte)-used for the removal of tumors of the nose.
11. *Mukulagra* (like ends of flower bud)-collyrium instrument-used for applying *anjana* (collyrium).
12. *Mālatīpuṣpavṛntāgra* (like the stem of Malati flower)-urethral sound used for clearing the urethra.

The *upāyantra* - Accessory Instruments

The sixth class of the blunt instruments comprises the *upayantra* or accessory instruments. By surgical instruments, the Hindus consider not only the instruments proper, but also any mechanical aid by which the object of the surgical treatment is attained. Thus even medicinal agents are considered under this head for they help the inflammatory swellings to subside, or suppurate, or burst open as by various external

applications. The accessory instruments are.

1. *Rajju* – thread
2. *Venika* – twine
3. *Paṭṭa* – bandages
4. *Carma* – leather
5. *Valkala* – bark of trees
6. *Lāṭa* – creepers
7. *Vastra* –cloth
8. *Asthilaśma* – circular stone or pebble
9. *Mudgara* – hammer
10. *Saṇipadalata* – palm of the hand and sole of the foot
11. *Aṅguḷi* – finger
12. *Jihva* – tongue
13. *Danta* – tooth
14. *Nakha* –nail
15. *Mukha* – mouth
16. *Vāla* – hair
17. *Aśvakaṭaka* – the ring of a horse's bridle
18. *śākha* – branch of a tree
19. *Sthivana* – spittle
20. *Pravahana* – fluxing the patient
21. *Harṣa* – objects exciting happiness
22. *āyaskānta* – a loadstone
23. *Kṣāra* – caustic
24. *Agni* – fire
25. *Bhēsaja* – medicines

THE SASTRAS (SHARP INSTRUMENTS)

1. *Mandalāgra* -round-headed (circular) knife.
2. *Karapatra* -Bone saw (like the human hand)
3. *Vṛddhipatra* -Scalpel or dissecting knife (like the leaf of vrddhi –an unknown medicinal plant) or a razor.

4. *Nakha śāstra* -nail or parer
5. *Mudrika* -finger knife (like the last phalanx of the index finger)
6. *Utpalapatra* -a knife i.e. resembling the petal of a blue lotus (Nymphaea stellata, Willd)-Lancet.
7. *Arddhāhara* -a single edged knife.
8. *Suci* – needles
9. *Kuśapatra* – a knife shaped like the *kusa* grass (eragostris Cynsuroides).
10. *Atimukha* –a knife shaped like the beak of the *Ati* bird (Turdus Ginginianus)
11. *śārāri mukha* – a pair of scissors like the beaks of *śārāri* bird
12. *Antarmukha* (having internal sharp edge) a kind of scissors
13. *Trikurccaka* – an instrument consisting of three needles.
14. *Kuṭharika* – a small axe shaped instrument
15. *Vṛhamukha* - a trocar shaped like a grain of rice
16. *Ara* - awl
17. *Vētasa patraka* – an instrument shaped like the leaf of a rattan (Calcamus Rotang)
18. *Vaḍiśa* – an instrument shaped like the fish – hook.
19. *Dantaśaṅku* – tooth-pick
20. *ēsāni* - sharp probe-like instrument.

The dimensions of these instruments are given in detail by old writers, who at the same time recommend that new implements and instruments should be introduced in accordance with the exigencies of the time and with the advice of experienced and competent surgeons. It is also enjoined that the instruments should be made of the best steel, for the manufacture of which India has been celebrated from the remotest times; they should be well shaped, with sharp flawless edges, and should be kept in handsome, portable wooden boxes, with a separate compartment for each instrument. The surgical operations are performed on what are considered auspicious days. The patient is made to sit or stand with his face to the west. The surgeon should be cautious that no vital part, artery, vein, joint, or bone is carelessly injured in the course of the operation, and that the instrument does not go deeper than the requirements of the case actually demand. In serious surgical operations, and in diseases of a painful nature, the patient was made insensible by the administration of anesthetics.

THE ANUSASTRAS (SUBSTITUTES)

In cases of children, or of patients having a dread of the knife, or where the proper instruments cannot be procured, bamboo, crystal, glass, *Kurvinda* (a kind of stone), leeches, fire, caustics, nail, *Karīra* (Capparis aphylla), *Nirguṇḍi* (Vitex Nigunda) hair and finger may be made use of. They are called *Aṇuśāstra* (substitutes) and also employed as incisive instruments. The nail may be used in extracting a solid body, leeches in extracting blood, and hair, finger or vegetable sprout for probing. Caustics are used in opening abscesses, and fire (live charcoal) is applied to snakebites and to wounds that are intensely painful.Thus there are three modes adopted by the Hindu surgeons for treating the surgical cases- *śāstra karma (surgery)*, *Kṣārakarma* (caustics) and *Agnikarma* (cautery). In the opinion of *śuśṛta*, *Kṣāra karma* is better than the *Sastra karma* and *Agnikarma* better than either.

śuśṛta'S SURGICAL SKILLS

śuśṛta states the supremacy of the surgery "It is regarded as the best of all the *Astangas* of *Ayurveda* because it gives quick results, uses *Yantras* and *śāstras*, *Kṣārakarma*, *Agnikarma* and as its help is sought for in all other branches of medical sciences. Surgery is eternal, sacred and a mean of obtaining heavenly life, reputation, long life and also lively hood".

Laporatomy

śuśṛta was the first surgeon who removed the bladder stone by the perineal route, a method that was still extensively in practice till the last century. He is also known as the first surgeon to perform the Cesarean section in extreme cases of obstructed labor.

Sandhi-Muktam and Kanda Bhagnam[12] (Dislocations and Fractures)-Orthopedics

Dislocations are characterized by inability of extension, flexion, circumfusion and rotation of the dislocated limb, which becomes extremely painful and cannot bear the least touch.

The *Sandhi-muktam* (dislocations) is divided into six types:

1. *Utplṣṭaṁ* -Fracture-dislocation.

2. *Visplṣṭaṁ* –Subluxation
3. *Vivartitam* –Dislocation with lateral displacement
4. *Avakṣiptam /Athaḥkṣiptaṁ* - Dislocation with downward displacement
5. *Ati-Kṣiptam*- Dislocation with overriding
6. *Tiryāk-Kṣiptam*- Dislocation with oblique displacement

In case of a joint by two articular extremities (*utpliṣṭam*) a swelling is found to appear on either side of the articulation, attended with a variety of pain at night. A little swelling accompanied by a constant pain and disordered function of the dislocated joint marks cases of simple looseness (*viśliṣṭam*) of the articulation, while pain and unevenness of the joint owing to the displacement of the connected bones distinguish a case of *vivartitam* (lateral displacement). An excruciating pain and looseness of the dislocated bone are the symptoms of a case in which a dislodged bone drops or hangs down from its joint (*adhah-Kṣiptam*). In a case of abnormal projection (*ati-Kṣiptam*) the dislocated bone is removed away from its joint that becomes extremely painful. A case of oblique dislocation (*tiryak-Kṣiptam*) is marked by the projection or displacement of the bone on one side accompanied by an intolerable pain.

The *Kanda* Bhaṅgaṁ (fractures) are divided into 12 kinds:

1. **Karkatakam** (Fracture with haemotoma): A case where a fractured bone, pressed or bent down at its two articular extremities, bulges out at the middle so as to resemble the shape of a knot.
2. **Asvakarnam** (oblique fracture): When the fractured bone projects upward like the ear of a horse.
3. **Curnitakam** (Communicated fracture): The fractured bone is shattered into fragments in a case of *curnitam* or it is comminuted kind of fracture, which can be, detected both the Palpation and precipitation.
4. **Picchitam** (Compression fracture): A smashed condition of the fractured bone marks a case of *picchitam*, which is often marked by great swelling.
5. **Asthi-cchalitam** (Sub-periosteal heamotoma): A case where the covering or skin of the bone is cast or splintered away.

6. **Kandabhagnam** (Transverse fractures): when the completely broken or severed bones project through the local skin.
7. **Majjanugatam** (Impacted fracture)**:** When a fragment of the fractured or broken bone pierces into the bone and digs out the marrow.
8. **Atipatitam** (Complete fracture). When the fractured bone droops or hangs down.
9. **Vakram** (Green stick fracture): When the unloosened bone from its position is bent down in the form of an arch it is called
10. **Cchinnam** (Incomplete fracture): When the only one articular extremity of the bone is severed
11. **Patitam** (Cracked fracture): When the bone is slightly fractured and pierced with a large number of holes. An excruciating pain being the leading indication.
12. **Sphutitam** (Fissured fracture): A case where the bone, largely cracked and swollen, becomes painful as if stuffed with bristles of *Suka* (kind of insect) is called *Sphuṭitam* (greenstick fracture).

Bandhanas (Bandages)

Susruta describes 14 varieties of bandages[10].

1. *Kōśa* – (Sheath Bandages): egg-shaped is applied to the joints of the thumb and fingers.
2. *Dāma*– (sling bandage): tail of a quadruped is tied round a part for the relief of pain.
3. *Svastika* - (cross/spica bandage): portico shaped is applied to the joints, to the spaces between the tendons of the great and second toe to the eyebrows and the breasts, to the soles, palms and the ears.
4. *Anuveḷita* – (Spiral bandage): encircling is applied to the limbs
5. *Pratōḷi / Mutōḷi* – (Windingbandage): is a broad bandage for the neck and penis
6. *Mandala* –(circular bandage): is applied to round parts
7. *Sthāgika* - (giving firmness- stump bandage): a bandage filled with paste, is applied to the end of the thumb, fingers and penis

8. *Yamaka*- single bandage for two wounds/ double is applied to ulcers
9. *Khartva* - (four tailed bandage): is for the cheeks, temples and lower jaw
10. *China* (banner)-(Eye bandage): is a bandage for the inner angles of the eyes
11. *Vibandha* (Many tailed)-a firm bandage is for the back, abdomen and chest
12. *Vitāna* (canopy/Capheline bandage)- is a large bandage for the head
13. *Gōphaṇa* – (a sling/T-bandage) for throwing stones is a concave bandage for the chin, nose, lips, shoulders and pelvis
14. *Panchangi* (bandage with five tails-for head & neck): is for the parts above the clavicles. Bandages are applied with three degree of tightness according to the seat of the inflammation, tight, medium and loose. When bones are comminuted, smashed, broken dislocated or put out of place, and when nerves and veins are torn, they rapidly get well under the application of bandages and the patient sleeps sits and moves about comfortably. The indications and contra-indications for the use of bandage are discussed fully by *śuśṛta*.

THE TECHNIQUE &MATERIAL FOR SUTURING[11]

The edges of the wound should be raised and brought into apposition with each other properly and then suturing should be done meticulously by a continuous suture with fine thread, bark of *Aśmāntaka*, thread of *Sana*, silk thread, tendon, hair or with fibers of *Mūrva* or *guduci*. In intestinal perforation large black ants heads are used for closing the wound. Suturing should be done neither too far to avoid painful, nor too near to avoid cuts through the margins of the wound.

Types of Suturing

1. *gōpanika* (reinforcing)
2. *tannasēvani* (darning)
3. *Rjugranthi* (interrupted)

Types of suturing needles

1. Round- Where the tissues are thin and in the joints the needle should be circular and two fingerbreadths in length is used.

2. Three-side- For thicker tissues, it should be straight, triangular bodied– three finger breadths long is used.
3. Curved like a bow: For vital spots, testicles and abdominal viscera semicircular needle is used.

CONCLUSION

Medicine and Surgery, though parts of the Medical Science are treated as distinct branches. If the physician requires to be perform a surgery says to his patient, "*Atra Dhanvantarinām adhikaras kriyāvidhau*" means "It is for the surgeon to take in hand this case". It reveals that the surgery might be considered as a separate entity of super specialty branch.

The innovative surgical instruments and appliances used by the ancients was no doubt very small and meager as compared with advanced technologies in the field of surgery of the twenty-first century.

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सारांश

शल्य चिकित्सा का विकास - सुश्रुत के परिवर्तनात्मक दक्षता

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शल्य चिकित्सा एवं चिकित्सा शास्त्र स्वस्थ विज्ञान के अविभाज्य अंग है। अनादिकाल से इन दोनों का विकास अपने अपने स्रोतों से स्वतन्त्र रूप में हुआ है।यह देखा गया है कि प्राचीन काल से ही चिकित्सा शास्त्र शल्य चिकित्सा के बिना अधूरा ही रहा था। चिकित्सा शास्त्र के इस भाग को शल्य चिकित्सा के एक पेशे के रूप में नहीं माना गया। जो पेशेंवार थे वे किसी न किसी निम्न जाती के और अनपढ थे। यह ज्ञान उन्हें मौखिक परम्परा द्वारा मिला था। प्राचीन काल से नाई ही प्रसिद्ध शस्त्र चिकित्सक थे और यह परम्परा सातवी तथा आठवी शतब्दी तक लागू रही। इसकी उल्लेख तमिलानडु के पांड्यन शिला लेखों में मिलता है। यूरोप में भी प्राचीन तथा मध्य युग में नाई ही शस्त्र चिकित्सक के रूप में प्रचलित थे।

सुश्रुत प्राचीन काल के महान शल्य चिकित्सक थे। इन्हें शल्य चिकित्सा शास्त्र के आद्य माना गया है। शल्य निर्हरण में उपयुक्त उपकरणों का एवं पद्धतियों का आविष्कार किया जो अपने आप में विकासोन्मुख है, जो उनके परिवर्तनात्मक दक्षता को दर्शता है। शल्य चिकित्सा के अनेक आधुनिक आविष्कारों का यह आधार बना है।