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A REVIEW ON INSIGHTS OF EXPERIMENTAL SURGERY IN *AYURVEDA* W.S.R *SEEVANA KARMA* IN DETAIL

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ABSTRACT

Acharya Sushruta known as 'Father of Indian Surgery' and he was the first person who learnt and practiced various surgical procedures in ancient India (approximately 300 BC), he was a disciple of *Dhanwantari sampradaya*. *Dhanwantari sampradaya* is considered as the surgical school of ancient India. The name of the sage-physician *Acharya Sushruta* is synonyms with surgery, from his treatise *"Sushruta Samhita"* a pioneer and authentic text book of *Shalyatantra*, it is evident that he has given prime importance to the *Shalyatantra* (Surgical discipline), he took the teaching and practice of surgery in ancient India to the admirable heights and that era was later regarded as "The Golden Age of Surgery". The teaching principles and techniques mentioned by *Acharya Sushruta* is unparallel and these principles can be applied even today, the skill of a Surgeon develops by the proper surgical training hence in-order to address the necessity of the surgical training and how to learn these surgical skills he dedicated a separate chapter called *Yogyasutriya Adhyaya* in *Suthrasthana*. In this review we will discuss the importance, comparative evaluation and relevance of *Yogyasutriya Adhyaya* in present era.

KEYWORDS: *Yogyasutriya*, Surgical training, Experimental surgery, *Yogya*, *Seevana karma*.

INTRODUCTION

In ancient India thousands of years ago there was an existence of speciality practice and even sophisticated and scientific methods of surgery were practiced in India. In *Sushruta Samhita* there is detail description about the exhaustive range of surgical methods, surgical anatomy, surgical instruments and dissection of dead body. Herodotus, the Greek historian quoted that the practice of medicine is very specialized among Indians. Each physician treats just one disease. The country is full of physicians, some treat eye, some the teeth, some of what belongs to the abdomen and others internal diseases.[1]

Surgery is an art with principles. For a Surgeon, besides having proper knowledge about surgical anatomy, surgical pathology, tissue respect, he must possess good knowledge about practical application of different instruments and execution of skill.[2] Surgery is a branch of medicine that requires specialised skills to perform the procedures, The skill of a surgeon develops by proper surgical training. Famous Sir Astley Cooper, President of the Royal College of Surgeons, said that 'without dissection there can be no anatomy, and that anatomy is our polar star, for without anatomy a surgeon can do nothing, certainly nothing well'.[3]

In *Yogyasutriya adhyaya*,[4] of *Sushruta Samhita Sutrasthana* he has enumerated the concept of experimental surgery to train the new practitioner's who would enter into surgical profession, to make them practice and gain practical experience of the Surgical skills and techniques over the experimental models in a safe and regulated environment.

LITERATURE REVIEW

Acharya Sushruta introduced the training of a surgeon to achieve dexterity in performing basic surgical and para surgical procedures on experimental models, this training protocol was named as *Yogya* and devoted *adhyaya* named as *Yogyasutriya*. It renders a safe, non-clinical environment designated to meet the educational needs of learners. To obtain complete success in the operating work, practice of similar procedure beforehand is called *Yoga* (experiment) and performance of such practice is called *Yogya*.

Experimental surgery has been strictly emphasized by *Acharya Sushruta* because dexterity requires the development of psychomotor competence, a process based on regular practice and expertise can only be gained by sustained deliberate practice. Thus, student should made to practice even after he has thoroughly

mastered the interpretations of all the scripture. He should get training on *Snehadi* and *Chedanadi* procedures. Otherwise even thoroughly mastered student faces failure in clinical practices due to lack of practical clinical skills.

This chapter deals with the *Ayurvedic* concept of experimental surgery, in this chapter skill enhancing techniques have been mentioned regarding how to make a *Shalya* scholar perfect in performing surgical practices. *Sushruta Samhita* explains eight types of *shastra karma* used for surgery which are very relevant and practiced today also. Practical surgical training of the scholars was mainly taught over some common objects that were easily available on those days.

1. *Chedana karma* (surgical excision)

It is a procedure to excise a damaged part using instruments like *Mandalagra* (circular knife), *Kharapatra* (bone saw), *Vriddhipatra* (scalpel), *Nakhashastra* (nail parer), *Mudrika* (ring knife), *Kartarti* (scissor) *Antarmukha shastra* (curved bistoury). For this procedure objects like *Kushmanda* (Pumpkin gourd), *Alabu* (Bottle gourd), *Kalindaka* (Watermelon), *Trapusa* (Cucumber) etc. are used by *Acharya Sushruta*. Different excision techniques should be practiced on these objects. These types of fruits have not so hard outer surface and inner part is bulky/ soft, so that a new practitioners can know how to hold a surgical blade for performing excision in different directions and application of the force required to excise different types of tissue with different surfaces and resistances.

2. *Bhedana karma* (Incision and exploration)

It is procedure made to explore under-lying structures and to let out the content by using instruments like *Vriddhipatra* (scalpel), *Ardhadhara* (single edged knife), *Mudrika shastra* (ring knife), *Nakha shastra* (nail parer), *Utpalapatraka* (lancet). For this procedure objects like water filled leather bag and bladder of the animals filled with mud or materials of slimy consistency are used. Whenever a new practitioner practices incision over such models, he will judge the tension of the wall, consistency of the fluid inside and the exact pressure required to incise in a single stroke and how to explore a cavity.

3. ***Lekhanakarma* (scraping)**

Scraping is useful to remove undesired tissues like epithelialized tissues, hyper granulations, sequestrum, vitiligo, ulcer margins etc. by using instruments like *Mandalagra* (circular knife), *Kharapatra* (bonesaw), *Vriddhipatra* (scalpel), *Nakhashastra* (nail parer). This procedure practiced over objects like dead animal skin with hair or fine leather with scanty wool are used. Its very small surgical procedure by which a new practitioner learns to scrape the area with delicate balance of instruments avoiding injury to underlying or nearby structures and learns to remove superficial thin tissues.

4. *Vyadhana karma* (puncturing)

This procedure used to pierce the epithelial surface, superficial veins etc. for this procedure very fine hand is necessary it is done using instruments like *Suchi* (suturing needle), *Kutharika* (chisel), *Vrihimukha* (trocar and canula), *Aara* (awl), *Vetasapatra* (a kind of scalpel), *Eshani* (sharp probe), *Kushapatra* (bistoury). This procedure practiced on objects like vessels of dead animals and lotus stalk are used because veins of animals are similar to humans and the lotus stalk possesses morphologically similarity to the superficial veins of human being. By this new practitioner gets an idea about handling of instruments, pressure required to penetrate into the vessel, its depth and gains dexterity to enter the vessels with precision and accuracy.

5. *Eshana karma* (probing)

This procedure should be practiced on Moth-eaten hollow pieces of wood, tube of bamboo and reed and the mouth of dried bottle gourd by using the instrument *Eshani* (Sharp probe). These objects have multiple holes and hollow passages, while practicing *Eshana karma* on these the new practitioner will develop clinical skill to assess the path way of sinuses, fistula tracks and cavities and gets ability to trace the path with least resistance and identify the nature of foreign body in terms of size, number and fixity.

6. *Aharana karma* (Extraction)

Removal of foreign body by pulling method is called *Aharana karma*. It is practiced using instruments like *Badisha* (sharp hook), *Dantashankhu* (tooth-scaler) etc. over the objects like *Panasa* (Jack fruit), *Bimbi* (Ivy gourd), *Bilwa phala majja* (Bael fruit) and teeth of the dead animals. By this new practitioner appreciate the optimum grip and force required to remove the impacted foreign body by causing least damage to the surrounding structures. So, the practical training of *Aharana karma* is useful to remove the impacted foreign body, stone, faecolith, etc. skilfully.

7. *Visravana karma* (drainage)

This procedure is used to remove the abnormal collections of fluids in body cavities and let out the vitiated *Rakta Dosha* (vitiated blood). It is practised using instruments like *Suchi* (suturing needle), *Aatimukha* (hawk bill scissor), *Antarmukha* (curved bistoury), *Shararimukha* (scissor), *Trikurchaka* (brush), *Kushapatra* (bistoury), *Khaja* (churner). This procedure is practiced on a piece of *Salmali* wood (silk cotton tree) coated with beeswax. The idea behind the selection of beeswax for *Visravana* karma because it is a soft material and when incision taken it will be similar feeling like skin incision. The bark of *Salmali* wood contains plenty of liquid material. So, whenever a new practitioner's practices *Visravana karma* on this model, he will be experienced on how to take fine incision for free flow of liquid and also learns to make superficial incision not going beyond skin.

8. *Seevana* (suturing)[5]

"Surgery is an art and suturing is a fine art", Suturing technique in *Ayurveda* is called as *Seevana, Seevana karma* is one of the *Shastra karma*. This procedure is defined for approximation of cut margins of wound, which are produced by surgical or non-surgical process. Anatomical approximation of margins has prime importance in surgical practice which is achieved through *Seevana*.

Definition of *Seevana karma*: Joining of the two bifurcated tissues is called *seevana karma*. Or the surgical procedure which is carried out with the help of *suchi* is called *seevana karma*.

Indication for *Seevana*: Diseases arising from *Medas, bhinna vrana* (incised wound), *Sulikhita vrana* (Scrapped wounds), *Sadyovrana,* and *chalasandhi vyapashrita vrana* (wounds over the moveable joints).

Contraindication for *Seevana*: Wound which are caused by the application of *Kshara* (alkali), by *Agni* (fire), by *Visha* (poison), *Maruta vahina vrana* (gas gangrene), *Antar lohita Shalya* (when there is presence of blood or any foreign material in the wound) – in this condition when suturing is done which leads to the infection of suture site and may precipitate septicemia in later condition.

Seevana dravya

1. *Seevana Sutra* (thread): It binds and holds the tissue together till wound gets healed

Materials used: *Ashmantaka valkala, Shanaja sutra, Snayu, Bala, Murva, Guduchi*.

Even heads of giant ant are used to staple a wound over intestine while performing surgery for *Chidrodara*.

2. *Suchi:* It is a sharp instrument which pierces the tissues and aids in suturing.

Types of *Suchis* are

***Vrutta* (Circular):** this is used in suturing the places like *Alpamamsa desha* (deficient muscle tissue), *Sandhi pradesha* (over joint area).

Aayata: this is used in suturing the places like *Mamsala pradesha* (muscle tissues).

Dhanuvakra: this is used in suturing the *Marma* (Vital points), *Phalakosha* (scrotum), *Udara* (Abdomen) and *Uras* (Thorax).

Qualities of Suchi

Tip - *tiksanaagra* (should be sharp)

Body - *susamahita* (should be equal in size)

End -*malati pushpa vrntagra parimandala* (should resemble the shape of jasmine bud)

Seevana karmabhyasa

It is practised using the instrument *Suchi* (suturing needle) and over the two edges of *Sukshma* or *ghana Vastra* (fine or thick cloth) and on the borders of *Mrudu charma* (leather). By this procedure new practitioner learns better approximation of edges, same tension across the wound, with knot security. Suturing of layers of varying thickness and application of different types of sutures.

Types of *Seevana karma*

1. *Ruju granti*: (*Ruju* means straight and *granti* means knot)

This suture is similar to that of simple interrupted suture.

2. *Vellitaka*: (*Vellitaka* means Creeper)

It resembles creeper can be quickly inserted and have only two knots at the beginning and end.

This suture is similar to that of continuous suture.

3. *Gophanika:* *(Gophana*- Sling like)

It resembles head of cow. It is blanket type of suture used on skins.

This suture is similar to that of continuous with locking / blanket suture.

4. *Tunnasevani*: (*Tunna*- torned piece of cloth, *Sevani*- to sticth)

It is done as like as the torn-up garments are sutured.

This suture is similar to that of sub-cuticular suture.

Principles of *Seevana* in *Ayurveda*

1. The suturing bites should be *Natiduro* (not too far) and *Natinikrushto* (not too near) from the edge of the wound.
2. When there is presence of *Pamshu* (sand), *Roma* (Hair), *Nakha* (Nails), *Asthi* (bones) in the wounds and which are moving inside the wound, they should be extracted otherwise it leads to *Paaka* (suppuration) of the *Vrana*.
3. While suturing if there are *Pralambi Mamsa* (hanging muscle tissue) they should be excised and the edges are elevated, approximated and sutured.
4. If the wound edges are dry or if there is no fresh blood on the edges, the edges are scraped to produce fresh bleeding and then they should be sutured.

Complications of *Seevana karma*

1. If the suturing bites taken too far from the wound edges which produces pain (*Duraad rujau*)
2. If the suturing bites taken too near from the wound edges then it slips / results in cut through from the edge (*Sannikrushtasya avalunchanam*)

Previous research

1. Experimental evaluation of horse hair as a nonabsorbable monofilament suture.[6]
2. Dermatologic Micro sutures Using Human Hair: A Useful Technique in Cutaneous Stitching.[7]
3. A review of clinical trial on evalution of *Taila Payita Amrutha Tantu* and Mersilk as suturing material w.s.r. to *Riju Granthi* technique in *Sadyo Vrana*.[8]

Suture

Suture is any material used to ligate blood vessels, tubular structures and ducts or to approximate tissues and

close wounds. Or A suture is any thread or strand which brings into apposition of two surfaces or tissues.

- **Suturing** – sewing together two structure using suture threaded on a needle
- **Ligature**- A Ligature is any thread or strand which obliterates the lumen of ductular structures.
- **Ligating** – tying a ductal structure such as blood vessel using a suture thread.

History of suture materials

- 3000BC Egyptians used thorns and needles to close wounds.
- 1000BC Indian surgeons used horse hair, cotton and leather. 2nd century Roman physician, Galen described gut sutures
- Late in 19th century, silk and catgut became popular.
- A south American method of wound closure used large black ants which bite the wound edges together and ant's body is then twisted off leaving the head in place.
- East Africa tribes closed the wound with Acacia thorns ligated blood vessels with tendons.

Qualities of Ideal suture material

- It should have Uniform Diameter.
- Possess knot security.
- Should have Adequate tensile strength.
- Minimum tissue reaction.
- Should be non-capillary, non-allergic, non-carcinogenic.
- Facilitate easy handling and less expensive.
- It should be Easily sterilized, retain its strength.
- Should not be fraying of end.
- Should not favor bacterial growth.
- Should not produce any magnetic field around it.

Classification

1. Based on origin (Natural, Synthetic)
2. Based on structure (Monofilament, Multifilament)
3. Based on resorption (Absorbable, non-absorbable)
4. Based on material (Metallic, Plastic, Liquid)

Suture Needles

Made up of stainless-steel alloy, which is resistant to corrosion.

Components: - Eye/Swaged end
- Body
- Point/Tip

Qualities of Ideal Surgical needle

- It should be made up of High-quality stainless steel.
- It should have smallest diameter as possible.
- Capable of implanting sutures with minimal trauma.
- Stable in the needle holder to tissues.
- Should be sharp. Sterile and corrosion resistant.

Principles of choosing a surgical needle

- Taper point needles are used to suture tissues that are easy to penetrate.
- Cutting or taper cut needles are used in tough, hard to- penetrate tissues.
- When in doubt about whether to choose a taper point or cutting needle, choose the taper point for everything except skin sutures.

Goals of suturing

- Wound edge apposition.
- Provide adequate tension.
- Maintain haemostasis.
- Aid in wound healing.
- Avoid wound infection.
- Produce aesthetically pleasing scar by approximating skin edges.

Principles of Suturing

- The needle should be grasped at approximately 1/3 of the distance from the eye & 2/3 from point.
- The needle should be pierced the tissue perpendicular to its surface.
- The needle should be placed equidistant (2- 3mm) from the incision line.
- The depth of penetration should be equal on both side of incision line.
- The needle should always pass from
- The movable tissue to the fixed tissue.
- Thinner tissue to the thicker tissue.
- Deeper tissue to the superficial tissue.
- The tissue never be closed under tension.
- Each suture must be placed 3-4 mm apart from the incision line.

Jenkins rule of suturing

For a continuous suture

- The length of suture used should be at least four times the length of the wound (T.P.N. Jenkins' rule)
- With each sutures placed 1 cm apart from each other.
- Taking bites 1 cm away from the wound edge on either side.

Techniques of suturing

Interrupted Stitches	**Continuous stitches**	**Mattress Stitches**	
		Horizontal	Vertical
Simple	Simple	Interrupted	Interrupted
Tension	Locking(blanket)	Continuous	Continuous
Figure of 8	Purse- string		

Criss-cross	Sub cuticular		

Principles of Suture removal

1. Suture area is first cleaned with normal saline.
2. The suture is grasped with non-tooth dissecting forceps & lifted above the epithelial surface.
3. Scissors are then passed through one loop & then transected close to the surface to avoid dragging contaminated suture materials through tissues.
4. The suture is then pulled towards the incision line to prevent dehiscence.
5. If suture entrapped in a scab application of hydrogen peroxide/normal saline is necessary.

- ***Bandhana karma* (bandaging techniques)**

Acharya Sushruta mentioned fourteen *Bandhas* according to the nature of the disease and season. *Bandhana* should be practised on different parts of the dummies made up of cloth. An appropriate *Bandhana* helps for protecting the wound, promotes healing of the wound and to stabilize fracture, dislocation, it helps to hold the dressing in place, to relieve pain and generally to make the patient comfortable.[6] By practising these techniques the new practitioner learns different bandaging techniques.

- ***Kshara and Agni karma***

Kshara and *Agni karma*, are of the most important Para surgical tools mentioned in *Ayurveda*. These procedures must be cautiously used on suitable points of the body otherwise it can result in serious trouble to the patient. Thus, one who desires to become skilled to use *Kshara karma* (alkaline therapy) and *Agnikarma* (thermal cautery), should practice on similar objects like a suitable soft muscle piece. Because the *Samyak dagda lakshana* can be observed better in muscle piece.

- ***Karna-sandhi Bandhana karma***

Yogyasutriya chapter also mentions about *Karna-sandhi Bandhana*, and for its practice, use of soft skin, soft muscle or flesh and hollow stalk of lily plant is indicated for fabricating the ear, joining severed ear and bandaging. By these new practitioner gets trained in reconstruction of tissues and grafting techniques.

- **Miscellaneous procedures**

Similarly, to become skilled in *Vasti karma* and *Vrana prakshalana*. It should be practised on the side hole of an earthen pot filled with water or with *alabu* (bottle gourd). In this procedure new practitioner learns proper insertion of *Basti netra* into the opening and maintaining the same pressure throughout the process of *basti pranidhana.*

An intelligent surgeon, who does experimental surgery methodically on such articles stated above, does not get confused while doing the actual operations. Therefore, one who wants to be an expert in the surgical procedures should practice the same experiments on similar objects.

Simulation

The act of mimicking a real object, event, or process by assuming its appearance or outward qualities is called simulation.

Simulation based learning in surgery is a learning model where an environment similar to real life surgical situation is created for the trainee to learn various surgical skills. Current simulation models including cadaveric, animal, model-based bench-top, virtual reality, robotic simulators, which are increasingly used in surgical training programme. These techniques help for repetitive practice on non-living things so that operator can be near perfect when operating on live patient.

Model-based simulation

This is mainly based on physical models. Procedures commonly include wound closure, urinary catheterization, venepuncture and I.V infusion. Models are useful for practicing relatively simple surgical procedures such as the removal of cyst and lipomas.

Computer based simulation

Computer simulations are more realistic simulations in which computers create illusions of reality. This technology creates visual environment which allows people to interact efficiently with three dimensional computerized databases in real time, using their natural senses and skills. Virtual reality combines a convincing representation of an organ system or body region with the means to work with that image as if it really existed.

Hybrid simulation

Hybrid simulators combine physical models with computers, using a realistic interface such as real diagnostic or surgical instruments. This avoids some of the technical difficulties associated with reproducing the feel of instruments and human tissue.

Team based simulation

Used in performing multiple tasks of entire procedure. For example, anaesthesia simulation.

DISCUSSION

According to *Acharya Sushruta*, though a disciple, even having studied the entire scripture should be subjected to practical work, because even having great learning, without undergoing practical training he will fail to perform the surgical procedures in Human due to lack of skills and surgical techniques. *Sushruta* had the desire to make skilled surgeons exactly similar to *Dhanwantari sampradaya* so that the legacy of it continues, so in order to solve this problem and to develop surgical skills among the disciples he started the practical training for surgery on common objects like fruits, vegetables, clothes, leather etc which were easily procurable. *Sushruta* has also clearly defined that an intelligent scholar can select other suitable objects to obtain

accurate, precise knowledge in particular procedures i.e *Shastrakarma, Ksharakarma* and *Agnikarma*.

There is no doubt; *Sushruta's* vision was very right in that time to make every student comfort and genius. These valuable concepts of *Sushruta* can be seen in surgical skills through simulation-based learning technique outside the operating environment prior to procedures on live patients.

CONCLUSION

A great similarity between *Sushruta's* concept of surgical training and simulation based surgical training is evident. *Acharya Sushruta* identified skills lie at the heart of surgical and medical practice. He designed experimental surgery to arouse active interest in the subject and to give a permanent mental impression of the basic surgical procedure. *Sushruta's* concept still remains valid, application may differ.

Surgical skills are required by a wide range of health care professionals, tasks range from simple wound closure to highly complex diagnostic and therapeutic procedures. Repetition of the surgical procedures over the models imparts perfection and boosts the confidence. The knowledge and attitudes in clinical practice are gained only by realistic learning environments and repeated practice. This regular practice also minimises the chances of failure. Because, more is the experience, better and complication- free are the results.

A surgery discipline scholar by enhancement of his surgical skills learns the correct execution of the surgical techniques, minimizes the post-operative complications and ultimately become capable of treating the patients with best positive outcome.

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