

**EVIDENCE OF SURGICAL INNOVATION IN AYURVEDA: A REVIEW
OF SHALYA TANTRA METHODOLOGY**

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1. ABSTRACT

The foundational architecture of operative medicine finds its earliest systematic expression in the classical traditions of Ayurveda, prominently championed by Acharya Sushruta. Venerated across medical history as the foundational pioneer of reconstructive, aesthetic, and plastic procedures, Sushruta compiled the Sushruta Samhita. This text serves as a comprehensive surgical compendium that transitions theoretical medical philosophy into meticulous, practical operative directives. Conceived as a pedagogical manual, the compendium provided ancient physicians with the necessary protocols to deliver comprehensive, holistic patient care. Parallel traditions within Ayurveda, notably championed by Acharya Charaka, similarly recognized the vital importance of Shalya Tantra (the surgical discipline) for pathological states where internal medical therapies were insufficient and urgent structural intervention was required. These conditions

prominently included Bhagandara (fistula-in-ano), Arsha (hemorrhoids), and Mudhgarbha (obstructed labor or intrauterine fetal complications). The ancient surgical toolkit

demonstrated a highly sophisticated adaptation of natural resources, featuring instruments engineered from organic substances including:

- High-grade timber
- Selected lithic (stone) compounds
- Specialized broad foliage
- Flexible, resilient arboreal branches

A unique nomenclatural approach was adopted, where instruments were named after the morphology of fauna and avian species—a practice that directly mirrors the anatomical and functional naming conventions seen in modern surgical instrument design.

Crucial to the preservation of patient safety and surgical efficacy was the mandatory requirement for *Yogya* (a rigorous preparatory simulation training system) that apprentices had to master on natural and artificial models before performing live operations.

This comprehensive review evaluates the complex methodologies detailed in the *Sushruta Samhita*, spanning across.

- Systematic surgical classifications (*Ashtavidha Shastra Karma*)
- Advanced material engineering of suturing and needles
- The science of complex mechanical support through specialized bandaging (*Bandhana*)
- Legal and ethical frameworks governing informed consent
- The strict environmental design of specialized operative suites (*Shalyagar*)

By evaluating these historical methodologies, this paper illustrates how the foundational frameworks of ancient Indian surgery continue to align with and support contemporary surgical practice.

KEYWORDS: Mudhagarbha, Shalyagar, Bandhana, Shalya Tantra, Yogya.

2. Introduction to Shalya Tantra and Ashtanga Ayurveda

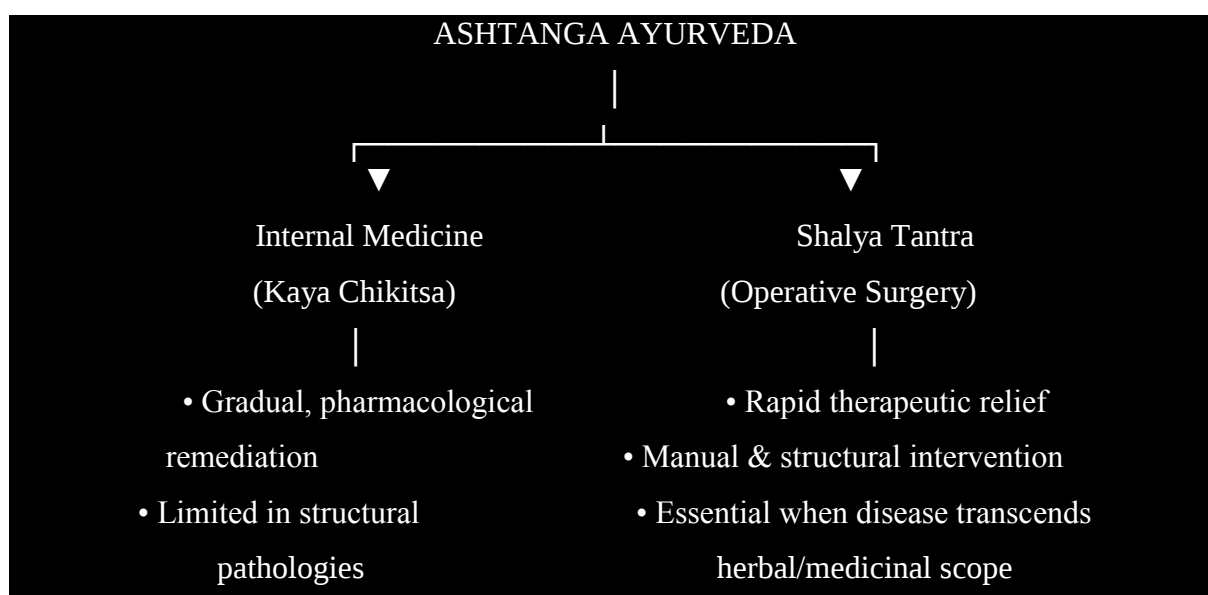
The *Sushruta Samhita* stands as an unparalleled historical monument within the domain of global operative medicine, providing comprehensive, detailed records of complex surgical procedures. This canonical work addresses a vast spectrum of pathologies, providing structured protocols for the management of.

- Neoplastic growths and deep tissue tumors
- Complex osseous fractures and dislocations

- Severe internal and external visceral trauma
- Acute obstetric crises
- Critical mechanical intestinal obstructions

Within the structural framework of Ashtanga Ayurveda—the classical eightfold categorization of comprehensive healthcare—Shalya Tantra is defined as the specialized branch focused on the extraction of extraneous substances (Shalya) that cause disease and disrupt physical and psychological equilibrium.

The classical definitions clarify that Shalya encompasses any foreign, intrusive matter that embeds itself within the biological matrix. These foreign bodies are systematically categorized into external organic and inorganic matter, including vegetal fragments, lithic particles, metallic shards, bone splinters, nails, and detached hair. Internal biological products can also act as Shalya when pathologically altered, such as deep-seated purulent accumulations or thick, coagulated blood clots. Furthermore, Shalya Tantra provides specific procedures for clearing the uterine cavity during life-threatening obstetric crises, including the extraction of a deceased fetus (Mudhagarbha) and managing severe fetal malpresentations to safeguard maternal survival.



The medical authority of Shalya Tantra stems from its capacity to deliver rapid, definitive therapeutic relief, presenting a stark contrast to the gradual, long-term actions of pharmacological or herbal formulations (Kaya Chikitsa). Acharya Sushruta recognized that when a disease process passes beyond the therapeutic capabilities of internal medicine,

surgical intervention must be utilized as the definitive line of defense. Consequently, precise operative parameters were established for treating deeply rooted abscesses, localized cysts, hypertrophied lymph nodes, chronic hemorrhoidal disease, obstructing urinary calculi, acute urinary retention, and complex mammary pathologies.

While internal medicine focuses on restoring physiological balance over time, Shalya Tantra intervenes directly to resolve immediate structural crises, making it an indispensable component of ancient medical science.

3. AIMS AND METHODS OF THE INQUIRY

Aims of the Study

The primary focus of this academic inquiry is to conduct a detailed, critical analysis of the surgical doctrines and operative paradigms preserved within the Sushruta Samhita. This study seeks to clearly outline the conceptual frameworks and practical methods of ancient Indian surgery, explicitly mapping the functional position of Shalya Tantra within the wider architecture of Ashtanga Ayurveda. By systematically organizing and reviewing Sushruta's complex surgical guidelines, this research aims to highlight their historical sophistication, scientific validity, and continuing relevance to the evolution of modern medical science.

MATERIALS AND METHODS

The methodology of this review relies on a rigorous analysis of qualitative data gathered from primary classical Ayurvedic texts, with a principal focus on the Sushruta Samhita. This primary evidence is analyzed alongside relevant secondary references, including contemporary historical reviews and peer-reviewed medical publications.

The research evaluates.

1. The organizational framework of ancient operative protocols.
2. The material properties and design principles of ancient instruments.
3. The clinical reasoning behind ancient pre-operative, operative, and post-operative management.
4. The analysis examines how Shalya Tantra achieved its high standing in antiquity by prioritizing immediate physical intervention. This exploration acknowledges both the historical limitations of the era—such as the lack of modern aseptic techniques and the discomfort caused by early metal alloys—and the brilliant, creative solutions developed

to overcome them, including specialized organic suturing materials and structured simulation training.

4. The Eightfold Operative Procedures (Ashtavidha Shastra Karma)

The core of Sushruta's operative methodology is organized into a highly structured framework known as the Ashtavidha Shastra Karma. This system categorizes all surgical interventions into eight distinct, fundamental actions. This classification covers the entire spectrum of mechanical interventions required to treat human tissue pathologies.

Sanskrit Term	Literal Meaning	Modern Surgical Equivalent & Clinical Applications
Chedana	Incision, Amputation, or Excision	Complete surgical removal of diseased tissue structures, organ parts, or necrotic limbs. Used for deep neoplasms, gangrenous tissue, and advanced localized pathologies. PDF
Bhedana	Incision for opening or tapping a cavity	Linear or deep structural incisions performed to puncture, open, or expose internal fluid-filled spaces. Applied in draining large abscesses or accessing deeper anatomical planes. PDF
Lekhana	Scraping	Active mechanical debridement or curettage of unhealthy, hypertrophied, or hyperplastic tissue margins. Vital for clearing chronic non-healing ulcers and clearing hyper-keratotic margins. PDF
Vyadhana	Puncturing	Sharp, targeted penetration of a distinct anatomical wall or vascular structure. Commonly performed for venesection, fluid aspiration, and paracentesis. PDF
Eshana	Probing	Careful mechanical exploration of complex blind tracts, abnormal fistulous openings, and deep sinuses. Essential for defining the anatomical path of a fistula before definitive repair. PDF
Aharana	Extraction	The manual or instrument-assisted removal of embedded foreign substances, impacted calculi, or a retained fetus. PDF
Visravana	Bloodletting or Drainage	Therapeutic evacuation of localized fluid collections, toxic blood accumulations, or purulent exudates. Utilized to reduce localized tension, compartment pressure, and clear deep infections. PDF
Seevana	Suturing	Accurate anatomical re-approximation of divided tissue edges using specialized needles and threads to facilitate primary wound healing. PDF

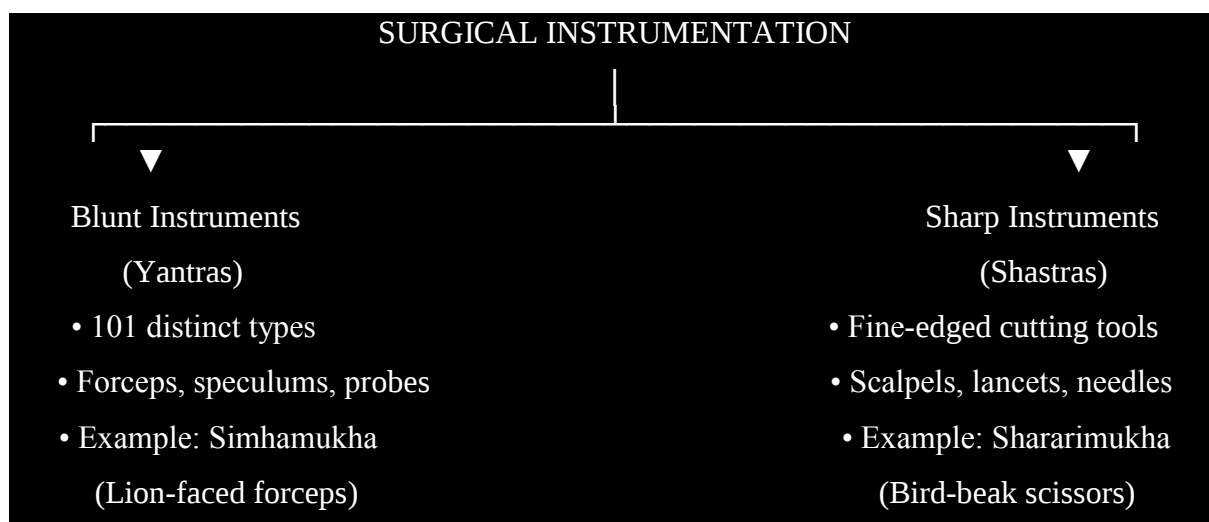
This eightfold division highlights a advanced understanding of surgical mechanics. Instead of viewing operations as isolated, unstructured maneuvers, the Ayurvedic tradition organized them into clear, foundational components. This allowed ancient surgeons to combine these basic actions to systematically plan and execute complex operations.

5. Ancient Surgical Instrumentation (Yantras and Shastras)

Sushruta famously stated that the human hand is the primary and most important instrument of the surgeon, yet he recognized that fulfilling complex procedures required specialized toolkits. The Sushruta Samhita details a diverse array of instruments, divided into two broad categories.

- Blunt instruments (Yantras)
- Sharp, cutting instruments (Shastras)

Sushruta meticulously classified 101 distinct blunt instruments, while subsequent authorities such as Acharya Vagbhata expanded upon these concepts, noting that the variations could be expanded indefinitely based on specific clinical needs.



In antiquity, when industrial metallurgy was in its early stages, these tools were carefully crafted from available organic, mineral, and early metallic elements. Materials included high-density timber, stones, specialized broad foliage, and sturdy arboreal branches. For less invasive procedures, flexible creepers and climbing plant tendrils were used as organic ligatures and tourniquets, showcasing an adaptive approach to resource utilization.

A notable aspect of this ancient toolkit was its nomenclatural framework, which drew analogies from the animal kingdom. Instruments were named based on their visual and functional similarity to specific fauna and birds. For example.

Simhamukha (Lion Forceps): Heavy blunt forceps designed with grasping tips resembling the powerful jaws of a lion, used for securing tissues or managing bony fragments.

Shararimukha (Scissors): Cutting instruments modeled after the long, slender, intersecting beak of the Sharari bird, functioning similarly to modern surgical scissors.

This design philosophy was not merely artistic; it served a practical pedagogical purpose, allowing students to immediately understand the grip, mechanical leverage, and intended function of a tool by recalling the behavioral anatomy of the corresponding animal.

Furthermore, Sushruta's Samdamsa Yantras represent the earliest historical prototypes of modern spring-loaded forceps, dissection tissue forceps, and dressing tools. Similarly, his tubular diagnostic instruments, the Nadiyantras, established the conceptual foundations for modern endoscopy, providing early methods for illuminating and inspecting deep internal tracts and body cavities.

6. Pedagogical Innovation: The System of Yogya

A major challenge in ancient medical education was ensuring students gained practical competency without risking patient safety during their learning curve. To solve this, the Dhanvantari lineage developed a rigorous system of simulation-based training known as Yogya. Long before modern medicine adopted synthetic models, Ayurvedic apprentices were required to master practical interventions by practicing on carefully selected natural and artificial objects that mimicked human pathology.

- **Incision and Excision Practices (Chedana / Bhedana):** Students practiced making precise incisions on gourds and fruits, such as Pushpaphala (*Cucurbita maxima* / pumpkin) and Alabu (*Lagenaria vulgaris* / bottle gourd). These fruits offered a realistic resistance that simulated human skin and subcutaneous fat layers.
- **Venesection and Vascular Management (Vyadhana):** To learn how to puncture veins safely without piercing through the posterior wall, students practiced on the blood vessels of deceased animals or fluid-filled channels embedded in soft materials.
- **Puncturing and Fine Drainage:** Precision puncturing techniques were rehearsed on the hollow, fibrous stalks of water lilies, which closely matched the delicate tactile feel of human cystic walls or fluid-filled cavities.

- **Extraction Operations (Aharana):** To develop the skills needed to remove foreign bodies or impacted calculi, trainers embedded solid materials inside the soft pulp of specific fruits, requiring students to extract them without causing widespread structural damage.
- **Bandaging Competency (Bandhana):** Students were required to master 14 distinct, complex bandage variations by practicing repeatedly on life-sized fabric mannequins, dummies, or structured models before treating actual patients.

This structured training plan ensured that an apprentice surgeon did not touch a live patient until they had demonstrated excellent hand-eye coordination, precise depth perception, and confident tool control.

7. Materials Science in Wound Closure: Suturing and Needles

The final stage of any major operative intervention is the reconstruction of divided tissue planes. In Shalya Tantra, this was achieved through an advanced approach to material science, encompassing both needle design and organic suture threads.

Needle Typology

Sushruta designed an array of needles tailored to specific tissue depths and structural densities. These needles were manufactured in various shapes, including.

- Straight needles for easily accessible superficial skin planes
- Curved and semi-curved needles for working in deeper, confined spaces
- Circular, triangular, and angular-triangular forms designed to pierce dense, tough fascial structures without blunt-force tearing

Suture Material Diversity

Ancient surgeons selected suture materials based on their biocompatibility, tensile strength, and degradation characteristics within the body. The toolkit included:

- Pure natural silk threads
- Spun cotton and organic jute fibers
- Prepared human hair and high-tensile horsehair (often used for delicate facial or cosmetic closures)
- Snayu (purified animal tendons), which provided exceptional strength for deep structural closures
- Inner bark sections of specific trees and flexible vegetal tendrils

For internal gastrointestinal closure, Sushruta developed a highly creative technique utilizing the powerful mandibles of large ants. During intestinal surgeries, such as repairing perforations, the wound edges were aligned, and the open mandibles of the ants were applied across the incision. Once the ant bit down and locked the tissue edges together, its body was carefully separated, leaving the clamped head in place. This acted as an early, biological, bioabsorbable surgical staple that securely held the tissue while safely dissolving over time.

Structural Principles of Suturing.

Acharya Sushruta established precise geometric rules for placing sutures, as recorded in his technical guidelines.

Spacing Error $\Rightarrow \begin{cases} \text{Excessive Distance from Margin} & \Rightarrow \text{Severe Ischemic Post-Operative Pain} \\ \text{Excessive Proximity to Margin} & \Rightarrow \text{Tissue Tearing and Mechanical Failure} \end{cases}$

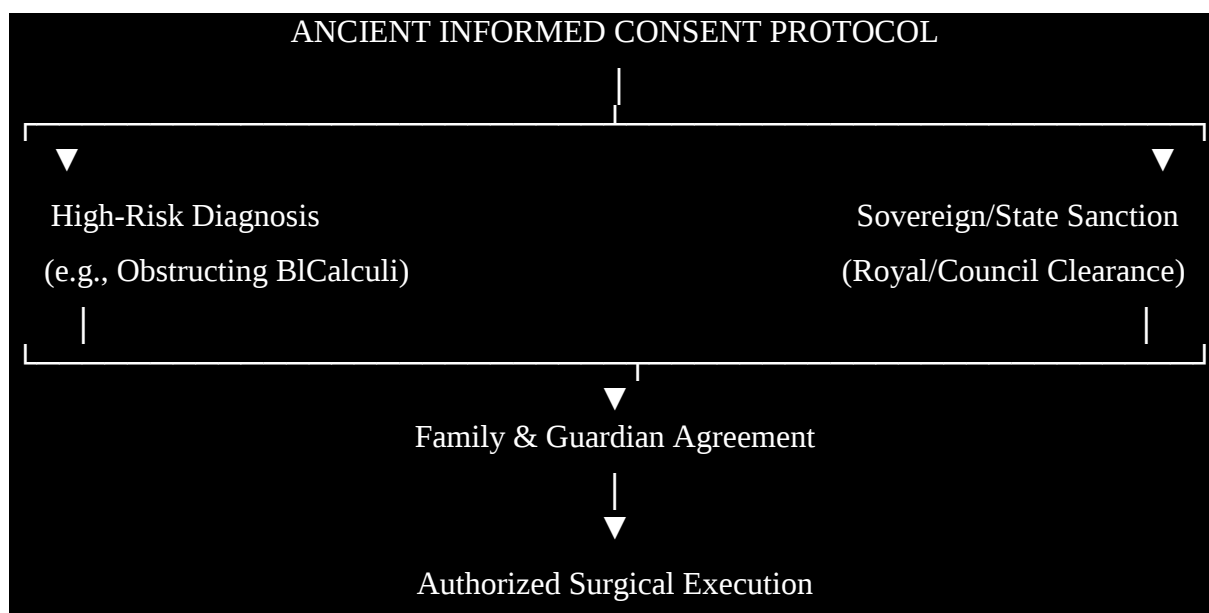
This mechanical insight, detailed in the classic verse 25/26 of the Sutra Sthana, reminds surgeons that placing sutures too far from the wound edge leads to tissue distortion and severe pain, while placing them too close causes the thread to cut through the fragile tissue margins, resulting in wound separation.

The text also details specific suturing patterns, including Rujugranthi (simple interrupted sutures), Anuvellita (simple continuous loops), Gophanika (blanket or interlocking stitches), and Tunnasevani (advanced subcuticular or Lembert-style closures designed to minimize visible scar formation).

8. Ethical Frameworks: The History of Informed Consent

A highly remarkable aspect of Shalya Tantra is its early development of medical-legal ethics and formal patient protection frameworks. Long before modern legal systems mandated informed consent, Acharya Sushruta recognized the high risks associated with major surgical interventions.

For high-stakes, life-threatening operations—such as Ashmari (lithotomy for large, impacted urinary bladder calculi)—the surgeon was explicitly instructed not to proceed without first obtaining formal authorization from relevant authorities. In ancient governance models, this meant securing the official sanction of the sovereign or a representative council, alongside the clear agreement of the patient's family, guardians, or relatives.



This protocol addressed three vital areas of medical practice:

1. **Validation of Risk:** It ensured that the patient's family fully understood the potential for intra-operative complications or death, protecting the surgeon from unfair blame if the patient passed away despite excellent care.

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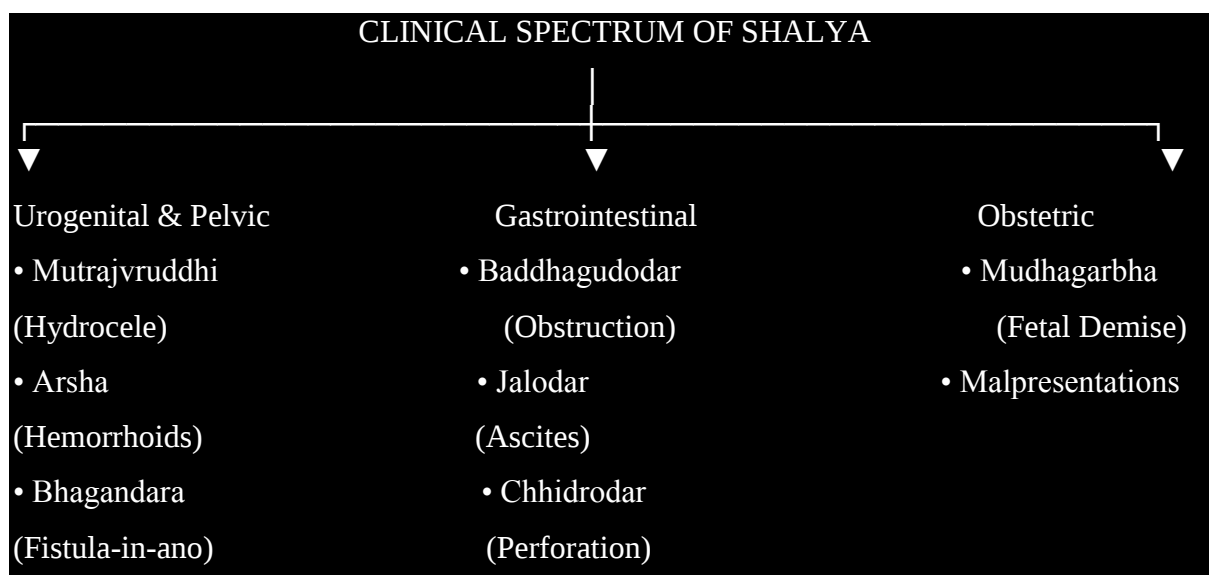
2. **Social and Legal Accountability:** It integrated the surgical practice within the legal framework of the state, ensuring that major operations were performed openly and responsibly.

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3. **Patient-Centered Care:** It recognized the value of the patient's life and choices, ensuring that major physical interventions were grounded in shared risk awareness and clear permission.

9. The Clinical Spectrum of Ancient Ayurvedic Surgery

The clinical records within the Sushruta Samhita show that ancient Shalya Tantra was not limited to minor, superficial procedures. Instead, it safely managed a wide variety of complex internal and structural disorders that parallel modern surgical specialties.



Urogenital and Pelvic Interventions

- **Mutrajvrudhi (Vaginal Hydrocele):** Advanced fluid accumulations within the tunica vaginalis were managed through precise fluid aspiration and pocket excisions.
- **Arsha (Hemorrhoidal Disease):** Treated using a multi-modal approach that combined physical excision (Chedana) with targeted thermal cauterization or localized chemical ablation using specialized alkaline caustics (Kshara).
- **Bhagandara (Fistula-in-ano):** Complex, deep fistulous tracts were explored using specialized probes (Eshana), opened completely, and managed with Kshara Sutra—a medicated, chemically active cutting thread that gradually debrided and healed the tract from the inside out.

Advanced Gastrointestinal Emergency Surgery

- **Baddhagudodar (Acute Intestinal Obstruction):** This life-threatening condition was managed by opening the abdominal cavity via a laparotomy incision, identifying the site of the mechanical obstruction, clearing the blockage, and restoring normal bowel alignment.

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- **Chhidrodar (Intestinal Perforation):** When patients suffered penetrating abdominal wounds or internal ulcer perforations, surgeons performed emergency exploratory operations, repaired the intestinal walls using organic sutures, cleared the peritoneal space, and closed the abdomen.

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- **Jalodar (Chronic Ascites):** Large fluid accumulations within the peritoneal cavity were drained using targeted abdominal paracentesis, utilizing specialized tubular instruments to safely evacuate fluid while avoiding internal organ damage.

Obstetric and Ophthalmic Interventions

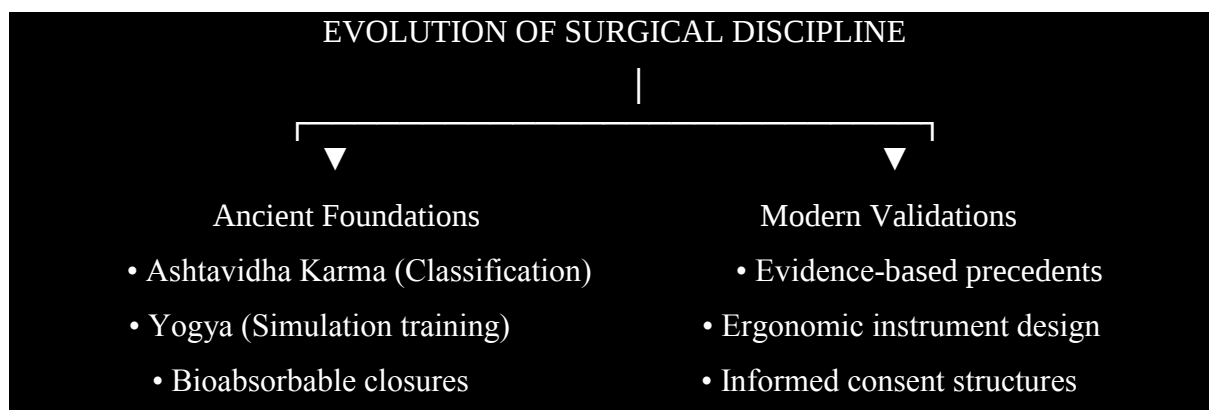
- **Mudhagarbha (Obstructed Labor & Intrauterine Fetal Demise):** When a fetus died in utero or became impacted during a severe malpresentation, threatening the mother's life, surgeons performed specialized internal maneuvers to safely extract the fetus and prevent maternal mortality.

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- **Kaphaja Linganasha (Cataract):** Sushruta detailed early ophthalmic couch procedures, using a fine, specialized needle to gently displace a clouded, opaque lens away from the visual axis, immediately restoring partial vision to blind patients.

10. Epistemological Conclusion and Modern Resonance

The surgical doctrines preserved within the Sushruta Samhita have demonstrated remarkable historical endurance, retaining their core scientific credibility even when analyzed under the lens of modern operative medicine. Acharya Sushruta's development of skin flap transpositions for nasal reconstructions established the foundational principles of modern rhinoplasty, rightfully earning him the global title of "Father of Plastic Surgery".



Modern reconstructive plastic surgeons and medical historians continue to find valuable insights within this classic text, as ongoing clinical and historical research seeks to document these ancient methods as early examples of evidence-based medicine.

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Rather than being viewed merely as an antique artifact, the Sushruta Samhita remains a vibrant, timeless repository of surgical knowledge. It serves as a vital bridge connecting early

human creativity with modern scientific advancement, proving that the core principles of patient care, structured training, and precise manual intervention remain unchanged across millennia.

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