



The Surgico-pharmacological Nexus in Sushruta Samhita: A Critical Review of the Interrelationship Between Shalya Tantra and Dravya Guna

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ABSTRACT

The *Sushruta Samhita* is one of the earliest systematic treatises on surgery and a major source of Ayurvedic pharmacological thought, combining operative technique with the use of medicinal plants. This critical literary review draws on the *Sushruta Samhita*, Acharya Dalhana's *Nibandhasangraha* commentary and peer-reviewed secondary literature. It aims to map Sushruta's classification of surgical procedures and instruments to modern equivalents and to appraise the pharmacological evidence for the *Gana* system. The text describes over 300 procedures within eight operative categories (*Ashtavidha Shashtra Karma*), including rhinoplasty and cataract couching, and 121 instruments (101 *Yantras*, 20 *Shastras*). It also organises 37 *Ganas* (drug groups) used to manage inflammation (*Shotha*), arrest bleeding (*Rakta-Stambhana*) and cleanse wounds (*Vrana-Shodhana*). Structured pre-operative (*Purva Karma*), operative (*Pradhana Karma*) and post-operative (*Paschat Karma*) care, with fumigation and boiling of instruments, indicates a systematic concern for patient safety and wound hygiene, although equivalence with modern asepsis is not established. A putative phytochemical and molecular-target correlation for the *Ganas* is offered as a hypothesis-generating framework; most supporting data are preclinical, and clinical validation for surgical applications is lacking. Comparisons with modern surgery are interpretive, and the review is limited by its narrative design and its reliance on translated texts.

INTRODUCTION

The *Sushruta Samhita*, attributed to Acharya Sushruta (believed to have lived between about 800 and 600 BC),^[1] is a foundational text of Indian medicine and of Ayurveda. Evolved through oral tradition and later preserved in *Sanskrit* manuscripts, it covers the eight classical branches of Ayurveda but places particular emphasis on surgery (*Shalya Tantra*).^[2] The extant recension has 186 chapters in two divisions, *Purva Tantra* and *Ut-tara Tantra*, describing 1,120 illnesses, 700 medicinal plants, 64 mineral-based and 57 animal-based preparations, and 42 surgical operative techniques.^[2,3]

Sushruta classified surgery into eight operative cate-

gories (*Ashtavidha Shashtra Karma*) and described more than 300 procedures and 121 instruments, classed as *Yantras* (blunt) and *Shastras* (sharp). He advocated cadaveric dissection (*Shava Chedana*) and repeated practice on natural models, such as fruits, vegetables, leather bags and wax, before operating on patients, an early form of structured surgical education.^[2–4] His *Nasikasandhana* (rhinoplasty), using a pedicled forehead or cheek flap, later became known as the Indian method and is a milestone in reconstructive surgery.^[3–6]

Beyond surgery, the text groups medicinal substances into therapeutic *Ganas* according to pharmacological action and clinical use. Contemporary studies report antioxidant, anti-inflammatory, antimicrobial,

analgesic, immunomodulatory and wound-healing activity in several of these plants.^[7-9]

The objective of this review is twofold: (i) to map Sushruta's classifications of surgical procedures and instruments, and the related therapeutic principles, to their modern equivalents, while examining critically how far these correspondences are supported by historical evidence; and (ii) to appraise the contemporary pharmacological evidence for the *Gana* system, distinguishing classical therapeutic descriptions from validated modern findings.

MATERIALS AND METHODS

This is a narrative critical literature review; no systematic search protocol or PRISMA-style reporting was followed. The primary textual sources were the *Sushruta Samhita* in the English translations of Sharma (1999 and 2001)^[2,18] and the *Nibandhasangraha* commentary of Acharya Dalhana; the instrument illustrations were taken from the translation of Srikantha Murthy (see Figure 1). Because translators render technical terms differently, Sanskrit terms are retained throughout, with English equivalents given in parentheses.

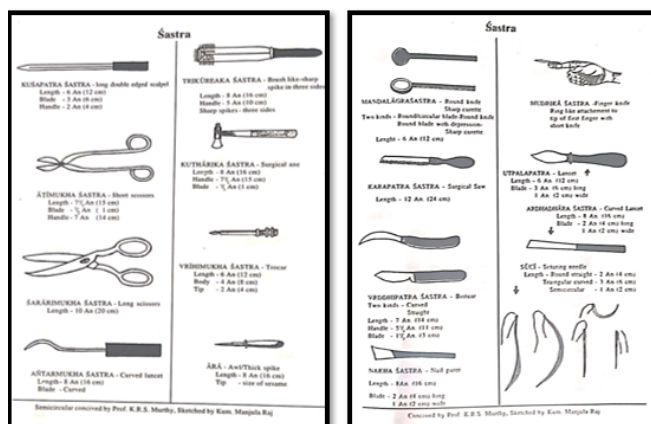


Figure 1: Reconstructed sketches of ancient Indian sharp surgical instruments (Shastras): (A) and (B).

Secondary literature was selected purposively for relevance, without a pre-registered protocol. The 19 journal articles cited were published between 2004 and 2026 and span the history of medicine, Ayurveda and *Dravyaguna* (pharmacognosy), pharmacology and surgery; three classical-text translations and three historical works are also cited. Surgical principles, procedures, instrument classification, drug groupings, and protocols on hygiene, ethics and education were examined for their correspondence with modern surgical science. Such correspondences are presented as interpre-

tive comparisons, not as proof of equivalence. The phytochemicals and molecular targets in Table 5 are listed at the level of the constituent plants and compounds and are not formulation-specific.

RESULTS AND DISCUSSION

Classification of Surgical

Procedures (Ashtavidha Shastra Karma)

Sushruta classified all surgical procedures into eight fundamental operative categories, collectively termed *Ashtavidha Shastra Karma* (Table 1).^[3]

Major Surgical Procedures Described in the Samhita

Table 2 summarises representative major procedures documented in the text, among the more than 300 operative procedures it records overall. The fetal extraction listed in Table 2 is described only after maternal death and is therefore a postmortem procedure, not equivalent to caesarean section on a living mother (see Discussion).

Surgical Instruments

The *Sushruta Samhita* describes 121 surgical instruments in two categories (Table 3), along with 20 suturing materials and techniques. Many are described as modelled on the forms of animals or birds (e.g., *Simhamukha*, “lion-faced” forceps) for grasping, incision and probing (Figure 1), and some have been compared with modern forceps, scalpels and catheters;^[10] the basis and limits of these comparisons are considered in the Discussion.

Preclinical Training, Operative Workflow and Asepsis

Before operating on patients, trainees practised incision (*Bhedana*) on gourds and cucumbers, scraping (*Lekhana*) on hairy hides, fluid extraction (*Visravana*) on leather bladders filled with dyed water, and suturing (*Sivana*) on fabric edges (*Yogya Vidhi*). Surgical care followed three phases: pre-operative (*Purva Karma*: sterilisation, dietary preparation), operative (*Pradhana Karma*: technical execution) and post-operative (*Paschat Karma*: pain control, wound care, diet). Fumigation (*Dhoopana*) with *Nimba* (*Azadirachta indica*) and *Guggulu* (*Commiphora mukul*), together with preparation of the operative field and positioning of instruments, shows a systematic concern for cleanliness and wound hygiene.^[11] The antimicrobial activity of such plants has been reported in laboratory studies, but traditional hygienic practice must be distinguished from evidence-based antisepsis, and the effi-

Table 1: *Ashtavidha Shastra Karma* – the eight fundamental surgical actions

No.	Surgical Action (Sanskrit)	Modern Equivalent	Description
1	<i>Chedana</i>	Excision	Cutting or excising tissue; used in procedures such as tumour removal and amputation
2	<i>Bhedana</i>	Incision	Piercing or incising a body part to drain fluid collections or abscesses
3	<i>Lekhana</i>	Scarification	Scraping of tissue to remove growths or unwanted material, e.g., in treating haemorrhoids
4	<i>Eshana</i>	Probing	Exploring a wound or fistula with a probe to locate foreign objects or determine the extent of a cavity
5	<i>Aharana</i>	Extraction	Removal of foreign bodies from the body
6	<i>Vedhana</i>	Puncturing	Puncturing of blood vessels, often for bloodletting
7	<i>Visravana</i>	Draining	Draining of fluid, pus, or blood from a wound or abscess
8	<i>Sivana</i>	Suturing	Stitching or suturing a wound or incision to close it and promote healing

Table 2: Representative surgical procedures described in the *Sushruta Samhita*

No.	Procedure	Description
1	Rhinoplasty	Reconstruction of the nose; the most advanced and unique technique of its time
2	Lithotomy	Removal of bladder stones through a suprapubic incision
3	Cataract surgery (“couching”)	A specialised needle displaces the clouded lens to restore temporary sight
4	Amputation	Limb amputation with emphasis on tourniquet use for haemostasis and careful wound management to prevent infection
5	Postmortem fetal extraction	Described as a final resort to save the child when the mother had died in childbirth, via abdominal incision; a postmortem procedure, not equivalent to caesarean section on a living mother
6	Hernia repair	Surgical reduction of hernias, repositioning the displaced organ and repairing the muscle wall
7	Fistula-in-ano surgery	Treatment using probes and cutting threads (<i>kshara sutra</i>) to excise the fistula tract
8	Treatment of haemorrhoids	Surgical excision, cauterisation, and ligation
9	Fracture management	Classification of fractures and dislocations, with reduction, splinting, and immobilisation

Table 3: Classification of surgical instruments

No.	Category	Count	Description	Examples
1	<i>Yantras</i> (blunt instruments)	101	Used for grasping, holding, or extracting	Forceps, speculums, tubes, probes, cannulas
2	<i>Shastras</i> (sharp instruments)	20	Used for cutting, incising, or scraping; forged from steel, sharpened to cut a hair, and tempered with oils or alkalis	Scalpels, lancets, trocars, needles

[Source: Illustrations conceived by K.R. Srikantha Murthy and sketched by Manjula Raj, from Murthy KRS, *An English Translation of the Sushruta Samhita* (Chaukhambha Orientalia, Varanasi).]

cacy of these fumigants under conditions of surgical wound contamination has not been demonstrated (see Discussion).

Anatomical Knowledge and Cadaveric Study

Anatomy was learnt through cadaveric dissection (*Shava Chedana*), using bamboo brushes to expose structures without direct incision.^[3] The text describes the *Sapta Twacha* (seven layers of skin), bones, joints, ligaments (*Snayu*) and muscles (*Mamsa*),^[12] and identifies 107 *Marmas* (vital points), classified as fatal (*Sadya Pranahara*, *Kalantara Pranahara*) or disabling (*Vaikalyakara*). This anatomical knowledge informed both surgical and pharmacological practice.^[13]

Reconstructive Surgery

In *Nasa Sandhana* (rhinoplasty), a forehead or cheek flap was measured with a leaf template, rotated on its vascular pedicle and stitched in place, with plant-stalk tubes supporting the nostrils. This “Indian flap” is regarded as a precursor of modern reconstructive surgery,^[4] and the concept of *Sandhana Karma* (union of separated tissues) is conceptually comparable with modern reconstructive principles.^[5] Sushruta is widely referred to as the father of plastic surgery.^[6,14]

Operative Technique, Education and Ethics

Operative technique included suturing, bandaging, cauterisation (*Agni Karma*) and alkaline cautery (*Kshara Karma*), with step-by-step guidance on patient preparation, positioning, incision planning and post-operative care. Training combined a year of theoretical study with practice on leather bags and pumpkins. Sterilising tools by fire and boiling water, washing the hands and skin, maintaining a quiet, clean operating room and applying antiseptic herbal dressings are described as hygienic measures comparable in intent with modern aseptic practice. The ethical code required surgeons to be compassionate, sober and truthful, and Sushruta is widely designated the “Father of Surgery.”^[1,10,14–17]

Pharmacological Classification – the Gana System

Sushruta classified medicinal substances into *Ganas* by therapeutic action, pharmacological property and clinical utility (Table 4).^[7–9,18] Representative applications include urinary disorders (*Varunadi*, *Veeratarvadi*); fracture healing (*Lakshadi*); wound healing and anti-inflammatory action (*Nyagrodhadi*, *Rodhradi*, *Ambashthadi*); digestive and metabolic regulation (*Triphala*, *Trikatu*); rejuvenation and immunomodulation (*Guduchyadi*, *Kakolyadi*, *Amlakyadi*); skin and

infectious disease (*Haridradi*, *Patoladi*); and the *Panchamula* groups (*Laghu*, *Bruhat*, *Valli*, *Kantak*, *Trina*), used for anti-inflammatory, analgesic and restorative purposes. This system supported rational drug selection and polyherbal therapy and is regarded as a foundation for later Ayurvedic pharmacology and herbal research.

To situate these classical groupings within a modern pharmacological framework, Table 5 lists, for each of the 37 *Ganas*, putative bioactive phytochemicals and proposed molecular targets. These entries are given at the level of the constituent plants and compounds, not of the formulations themselves, and are informed by the general pharmacological literature.^[19–22] They are presented as a hypothesis-generating framework, not as validated mechanisms: most of the underlying evidence is preclinical (in vitro or animal studies), and no clinical trial known to the authors has validated these formulations for the surgical applications proposed.

Legend: Phytochemicals, molecular targets and applications are putative. They are listed at the level of the constituent plants and compounds, are not formulation-specific, and are largely based on preclinical studies; each entry requires verification against primary studies before any clinical inference is drawn. Abbreviations: AChE, acetylcholinesterase; AMPK, AMP-activated protein kinase; AQP3, aquaporin-3; BPH, benign prostatic hyperplasia; COX-2, cyclooxygenase-2; CYP3A4, cytochrome P450 3A4; eNOS, endothelial nitric oxide synthase; EPO, erythropoietin; GABA-A, gamma-aminobutyric acid type A; GFR, glomerular filtration rate; GLUT-4, glucose transporter 4; H1, histamine receptor type 1; HMG-CoA, 3-hydroxy-3-methylglutaryl coenzyme A; IFN- γ , interferon gamma; IgE, immunoglobulin E; IKK, inhibitor of nuclear factor kappa-B kinase; IL, interleukin; iNOS, inducible nitric oxide synthase; 5-LOX, 5-lipoxygenase; LUTS, lower urinary tract symptoms; MMP, matrix metalloproteinase; mTOR, mammalian target of rapamycin; NF- κ B, nuclear factor kappa B; NO, nitric oxide; NOS, nitric oxide synthase; Nrf2, nuclear factor erythroid 2-related factor 2; PGE2, prostaglandin E2; PPAR- γ , peroxisome proliferator-activated receptor gamma; RBC, red blood cell; RUNX2, runt-related transcription factor 2; SGOT, serum glutamic oxaloacetic transaminase; SGPT, serum glutamic pyruvic transaminase; SOD, superoxide dismutase; STAT3, signal transducer and activator of transcription 3; TGF- β 1, transforming growth factor beta 1; TNF- α , tumour necrosis factor alpha; TRPV6, transient receptor potential vanilloid 6; UTI, urinary tract infection; VEGF, vascular endothelial growth factor.

Table 4: Classification of drugs (*Gana*) in the *Sushruta Samhita*

No.	<i>Gana</i> /Formulation	Uses in Disease
1	<i>Vidarigandhadi</i>	Balances <i>Pitta-Vata</i> ; cough, asthma, fever, tuberculosis
2	<i>Aragwadhadi</i>	Skin disease, worm infestation, diabetes, poisoning, fever
3	<i>Varunadi</i>	Head disease, <i>Kapha</i> disorders, obesity, internal abscess
4	<i>Veeratarvadi</i>	<i>Vata</i> disorders, pain, flatulence, piles, urinary stones
5	<i>Salasaradi</i>	Skin disease, leprosy, obesity, diabetes, itching
6	<i>Rodhradi</i>	Diarrhoea, piles, bleeding disorders, leucorrhoea
7	<i>Arkadi</i>	Worm infestation, leprosy, skin disease, poisoning, fistula
8	<i>Surasadi</i>	Worm infestation, poisoning, skin disease, fever, cough
9	<i>Mushkakadi</i>	Diabetes, piles, anaemia, obesity
10	<i>Pippalyadi</i>	Common cold, loss of appetite, abdominal lump, colic, indigestion
11	<i>Eladi</i>	Poisoning, itching, skin eruptions, urticaria
12	<i>Vachadi</i>	Purification of breast milk, diarrhoea, indigestion
13	<i>Haridradi</i>	Purification of breast milk, diarrhoea, indigestion
14	<i>Shyamadi</i>	Purgation, constipation, abdominal distension
15	<i>Bruhatyadi</i>	<i>Tridosha</i> imbalance, loss of appetite, heart disease, dysuria
16	<i>Patoladi</i>	Loss of appetite, fever, wounds, vomiting, itching, poisoning
17	<i>Kakolyadi</i>	Lactation defects, emaciation, improves strength
18	<i>Ushakadi</i>	Obesity, urinary stones, diabetes, dysuria, abdominal lump
19	<i>Sarivadi</i>	Bleeding disorders, thirst, burning sensation, fever
20	<i>Anjanadi</i>	Bleeding disorders, poisoning, burning sensation
21	<i>Parushakadi</i>	Burning sensation, heart disease, thirst; appetizer
22	<i>Priyanguvadi</i>	Fractures, wounds, healing, diarrhoea
23	<i>Ambashthadi</i>	Diarrhoea, dysentery, bleeding disorders
24	<i>Nyagrodhadi</i>	Wounds, burns, fractures, healing
25	<i>Guduchyadi</i>	Fever, skin disease, burning sensation, diabetes, female disorders
26	<i>Utpaladi</i>	Vomiting, diarrhoea, loss of appetite, thirst, fever
27	<i>Mustadi</i>	Burning sensation, bleeding, poisoning, vomiting
28	<i>Triphala</i>	Eye disease, constipation, rejuvenation
29	<i>Trikatu</i>	Indigestion, obesity, diabetes, cough, cold, asthma
30	<i>Amlakyadi</i>	Constipation, acidity, burning sensation
31	<i>Trapvadi</i>	General debility, eye disease, loss of appetite
32	<i>Lakshadi</i>	Skin disease, worm infestation, swelling, fractures
33	<i>Laghu Panchamula</i>	<i>Vata-Pitta</i> disorders, fever, burning sensation
34	<i>Bruhat Panchamula</i>	<i>Vata-Kapha</i> disorders, fever, dyspnoea, indigestion, urinary stones
35	<i>Valli Panchamula</i>	<i>Vata</i> disorders, weakness; improves strength
36	<i>Kantak Panchamula</i>	Cough, asthma, hiccups, chest disease
37	<i>Trina Panchamula</i>	<i>Pitta</i> disorders, bleeding, burning sensation, dysuria

Table 5: Putative phytochemical and target biomarker correlation matrix of the 37 *Sushruta Gana* formulations (hypothesis-generating; not validated for the formulations)

No.	Gana/Formulation	Key Bioactive Phytochemicals	Target Biomarkers/ Pathways	Proposed Clinical/Shalya Tantra Application
1	<i>Vidarigandhadi</i>	Puerarin, daidzein, isoflavones, saponins	Upregulates VEGF, eNOS; downregulates TGF- β 1	Angiogenesis, tissue regeneration, post-op recovery
2	<i>Aragwadhadi</i>	Rhein, alpinumisoflavone, fistulic acid	Inhibits IKK, NF- κ B, TNF- α , IL-6	Broad-spectrum antimicrobial, <i>Vrana Shodhana</i>
3	<i>Varunadi</i>	Lupeol, varunol, rutin, quercetin	Decreases urinary oxalate; inhibits COX-2, iNOS	Antilithic, anti-inflammatory, BPH
4	<i>Veeratarvadi</i>	β -Sitosterol, tannins, catechins	Regulates TRPV6 channels; reduces IL-1 β , TNF- α	Lithotriptic; relieves <i>Mu-trakrichra</i>
5	<i>Salasaradi</i>	Pterostilbene, liquiritigenin, epicatechin	Inhibits α -glucosidase; downregulates PPAR- γ	<i>Medohara</i> , antiseptic, hypoglycaemic
6	<i>Rodhradi</i>	Loturine, colloturine, betulinic acid	Inhibits MMP-2, MMP-9	Haemostatic, astringent; reduces post-op seroma
7	<i>Arkadi</i>	Calotropin, uscharin, voruscharin	Inhibits Na ⁺ /K ⁺ -ATPase; activates caspase-3, -9	Wound debridement; excision of necrotic tissue
8	<i>Surasadi</i>	Eugenol, methyl eugenol, ursolic acid	Inhibits biofilm formation; downregulates interleukins	Antimicrobial, larvicidal; treats infected wounds
9	<i>Mushkakadi</i>	Plumbagin, alkaloids, oxyanthraquinones	Stimulates AMPK pathway; inhibits lipogenesis	Anti-obesity, <i>Kshara Karma</i>
10	<i>Pippalyadi</i>	Piperine, piperlongumine, essential oils	Enhances bioavailability; stimulates GLUT-4 translocation	Carminative; prevents post-op ileus
11	<i>Eladi</i>	Elettarin, zingiberene, cardamomin	Inhibits H1 receptors; decreases IgE	Antipruritic, anti-allergic
12	<i>Vachadi</i>	α -Asarone, β -asarone, acoradin	Modulates GABA-A receptors; decreases AChE	Neuroprotective, anti-inflammatory
13	<i>Haridradi</i>	Curcumin, demethoxycurcumin, berberine	Inhibits STAT3, NF- κ B; upregulates Nrf2	Advanced wound healing, surgical antiseptic
14	<i>Shyamadi</i>	Operculin, jalapin, alpha-peltatin	Stimulates colonic AQP3; induces purgation	<i>Virechana</i> , pre-operative detoxification
15	<i>Bruhatyadi</i>	Solasoline, solamargine, diosgenin	Inhibits 5 α -reductase; decreases PGE2	Diuretic, anti-inflammatory; manages dysuria
16	<i>Patoladi</i>	Cucurbitacin B, tinosporaside, kutkin	Decreases SGOT, SGPT, bilirubin; inhibits TNF- α	Hepatoprotective, <i>Rakta-Prasadana</i>
17	<i>Kakolyadi</i>	Shatavarin IV, withanolides, saponins	Upregulates collagen type I, fibroblast growth	Anabolic, angiogenesis; <i>Vrana Ropana</i>
18	<i>Ushakadi</i>	Ammonium chloride, trace silicic acid	Modulates renal H ⁺ excretion; dissolves mucus	Sialagogue; <i>Ashmarihara</i>
19	<i>Sarivadi</i>	Hemidesmine, hyperoside, rutin	Scavenges free radicals; reduces thromboxane A2	Haemoneuroprotective; relieves <i>Daha</i>
20	<i>Anjanadi</i>	Gallic acid, ellagic acid, iron complexes	Inhibits intestinal motility; promotes clotting	Anti-haemorrhagic; stabilizes mucosal bleeding
21	<i>Parushakadi</i>	Grewinol, anthocyanins, quercetin-3-O-glucoside	Decreases gastric H ⁺ /K ⁺ -ATPase activity	Acid neutraliser; relieves post-op thirst/vertigo
22	<i>Priyangvadi</i>	Callicarpenal, triterpenoids, tannins	Upregulates fibrin polymerization; vasoconstrictor	Haemostasis in major trauma
23	<i>Ambashthadi</i>	Mangiferin, tannins, punicalagin	Inhibits NOS; astringent mechanism	Anti-diarrhoeal; closes chronic fistulas
24	<i>Nyagrodhadi</i>	Leucocyanidin, fucosin, β -sitosterol	Cross-links collagen; decreases capillary leakage	<i>Sandhania</i> ; controls surgical shock
25	<i>Guduchyadi</i>	Tinosporin, cordifolide, berberine	Activates macrophages; enhances IL-12, IFN- γ	Immunomodulator; prevents nosocomial infection
26	<i>Utpaladi</i>	Nymphaeine, nuciferine, kaempferol	Inhibits voltage-gated calcium channels	Cardioprotective; relieves intracranial heat
27	<i>Mustadi</i>	Cyperene, mustakone, α -cyperone	Inhibits 5-LOX; reduces leukotrienes	Anti-inflammatory, antipyretic; post-op fever
28	<i>Triphala</i>	Chebulinic acid, corilagin, gallic acid	Activates AMPK; downregulates mTOR	Collagen synthesis, granulation tissue
29	<i>Trikatu</i>	Piperine, gingerol, shogaol	Inhibits P-glycoprotein, CYP3A4	Bio-enhancer of surgical drugs; stimulates peristalsis
30	<i>Amlakyadi</i>	Ascorbic acid, phyllembin, tannins	Upregulates SOD and catalase	Enhances phagocytosis; prevents oxidative injury
31	<i>Trapvadi</i>	Cucurbitacin E, fatty acids, trace zinc	Modulates detrusor muscle via M3 receptors	UTI-related incontinence; urinary calculi
32	<i>Lakshadi</i>	Laccraic acid, erythrolaccin, resin	Upregulates osteoblast differentiation (RUNX2)	Bone healing; comminuted fractures
33	<i>Laghu Panchamula</i>	Solasodine, tribuloside, gitogenin	Increases NO in corpus cavernosum; diuretic	LUTS resolution
34	<i>Bruhat Panchamula</i>	Oroxylin A, baicalein, aegeline	Inhibits HMG-CoA reductase; blocks histamine	Visceral inflammation; oedema at operative site
35	<i>Valli Panchamula</i>	Diosgenin, saponins, glycosides	Modulates EPO receptors; enhances RBC count	Post-operative anaemia; enhances <i>Ojas</i>
36	<i>Kantak Panchamula</i>	Solamargine, betulin, gymnemagenin	Activates AMPK; upregulates insulin sensitivity	Diabetic complications in surgical wounds
37	<i>Trina Panchamula</i>	Cylindrin, arundoin, ferulic acid	Inhibits carbonic anhydrase; increases GFR	Aquaretic; flushes microcalculi

Discussion

The *Sushruta Samhita* is among the earliest surviving texts to organise surgery systematically, with a classification of operative actions (Table 1), a catalogue of instruments (Table 3) and defined phases of perioperative care. The main value of these findings is historical and conceptual: they show how an ancient tradition framed operative practice. Correspondences with modern surgery are, however, interpretive and should be read as analogies of intent, not as proof of equivalent function or outcome.

Anatomical knowledge. The accuracy of Sushruta's anatomical descriptions has been debated. Cadaveric preparation by maceration and brushing allowed study of gross form and structure,^[3,12] but some descriptions of internal organs, vessels and the *Marmas* are considered schematic or concept-driven, and their match with modern anatomical terms depends on translation choices.^[12] The anatomical content of the text should therefore not be assumed to equal modern descriptive anatomy.

Instruments. The resemblance of Sushruta's instruments to modern forceps, scalpels and catheters needs careful interpretation. Naming instruments after animals and birds describes their form and mode of action, so the resemblance is largely morphological and metaphorical; claims of functional equivalence would need independent support from excavated instrument assemblages, metallurgical analysis of surviving specimens and text-critical study of the descriptions. The sketches in Figure 1 are modern reconstructions based on textual measurements, not surviving artefacts, and the comparisons made here are accordingly descriptive.

Procedures. Several procedures need qualification. Fetal extraction after maternal death (Table 2) is a post-mortem procedure and should not be equated with caesarean section on a living mother, which is a different surgical and ethical proposition. Cataract couching displaces the clouded lens without removing it and is now known to carry serious risks of infection, raised intraocular pressure and lens dislocation; it was also practised in other ancient traditions, including the Graeco-Roman world,^[23] and cannot be regarded as uniquely Indian. Forehead-flap rhinoplasty is better documented as a distinctive reconstructive technique,^[4,6] although the textual description is brief and its relationship with the later Indian method known in Europe depends on historical transmission that is not examined here.

Hygiene and asepsis. Fumigation with *Nimba* and *Guggulu*, boiling of instruments and washing of hands show attention to cleanliness. Modern asepsis, how-

ever, rests on defined reduction of microbial load, validated sterilisation and outcome data. The antimicrobial activity reported for these plants in laboratory studies cannot be extrapolated to the efficacy of fumigation in preventing surgical-site infection, and studies testing these fumigants under conditions relevant to wound contamination are needed before any claim of equivalence with modern asepsis can be made. Traditional hygienic practice should be distinguished from evidence-based antisepsis.

Education and ethics. Training on models and cadavers and the ethical code for surgeons are consistent with a formal educational approach. The text alone, however, cannot establish how far these practices were followed in historical surgical practice.

Comparison with other ancient traditions. Other ancient societies also developed surgical knowledge. The Egyptian *Edwin Smith Surgical Papyrus* (c. 1600 BC) records a systematic, case-based approach to trauma,^[24] the Hippocratic writings describe the reduction of fractures and dislocations and the management of wounds,^[25] and Celsus's *De Medicina* documents a range of operations in the Roman period.^[23] Against this background, the distinctive features of the *Sushruta Samhita* are the breadth of its operative classification, its catalogue of instruments, its formal training on models and cadavers, and the integration of surgery with a pharmacological framework. These features do not by themselves establish overall precedence or superiority, and a fuller comparative history, including Chinese and Mesopotamian traditions, lies beyond the scope of this review.

Strength of the pharmacological evidence. Table 5 is a hypothesis-generating synthesis, not a validated pharmacological profile. The evidence is strongest for individual compounds such as curcumin, which has been studied extensively in vitro and in animal models for anti-inflammatory and wound-healing effects,^[19] although clinical evidence in surgical settings remains limited. For most *Ganas*, the data concern single plants or isolated compounds studied in vitro or in animals; polyherbal formulations as used in classical practice have rarely been tested as such, and the molecular targets listed were not demonstrated for the formulations themselves. We are not aware of clinical trials validating these formulations for the surgical applications proposed in Table 5, so a considerable gap remains between classical therapeutic description and validated modern efficacy. Future work should verify each entry against primary, compound-specific studies, standardise the botanical identity of the ingredients,

and test priority *Ganas* (for example for wound healing, haemostasis and fracture healing) in preclinical models and, later, in perioperative clinical trials.

Limitations

This is a narrative review without a systematic search protocol or PRISMA-style reporting, so the selection of secondary sources may be biased. It depends on translations of classical texts, in which translation choices can alter the meaning of technical terms; Sanskrit terms are retained for this reason. The pharmacological evidence summarised in Table 5 is predominantly preclinical and not formulation-specific. Because the review concerns a revered historical source, confirmation bias is a risk, and an effort has been made to distinguish textual description from evidence of practice or efficacy. The review also does not provide a full comparative history of other ancient surgical traditions.

CONCLUSION

The *Sushruta Samhita* is a significant historical document presenting a unified medico-surgical system that combines a classified body of operative procedures and instruments, structured perioperative care, and a pharmacological framework based on *Ganas*. Many of its principles, such as structured training, reconstructive technique and attention to hygiene and ethics, are of conceptual and historical interest to modern surgery. As a narrative review of classical texts and secondary literature, however, this study cannot establish that the *Ashtavidha Shastra Karma* remain clinically applicable today, or trace the influence of the text on modern surgical science; such claims would require clinical evidence and documented pathways of transmission. The phytochemical and molecular correlations in Table 5 are putative and mostly preclinical. Future research should include clinical trials of selected *Gana* formulations in perioperative care (for example in wound healing and haemostasis), archaeopharmacological and phytochemical studies of the plants identified, and archaeological and text-critical study of the instrument descriptions.

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REFERENCES

1. Dubey, A., Parveen, S., Syed, A. A., Mujoo, S., & Ali, F. (2020). Sushruta: The unrecognised pioneer in oral and maxillofacial surgery. *World Journal of Dentistry*, 11(6), 506–509. <https://doi.org/10.5005/jp-journals-10015-1777>
2. Sharma, P. V. (1999). *Sushruta Samhita* (Vols. I–III, 1st ed.). Chaukhambha Visvabharati.
3. Mallinath, I. T., Adithya, J. V., & Aradhyamath, S. (2022). Acharya Sushruta's contribution in the field of surgery. *Journal of Ayurveda and Integrated Medical Sciences*, 7, 75–85.
4. Singhal, G. D., & Singh, L. M. (1981). *Ancient Indian surgery based on Sushruta Samhita* (Vols. I–X). Singhal Publications.
5. Kumar, A., & Kumar, B. N. (2020). The principles of surgical practice: Sushruta Samhita and its importance to present day surgery. *Journal of Surgery Open Access*, 6(2), 1–5.
6. Deshpande, A. D., Kulkarni, R. V., Gosavi, S. A., & Aravind. (2024). A comparative review of plastic surgery concepts in Ayurveda and modern sciences. *Journal of Research in Traditional Medicine*, 10(2), 57–64.
7. Vijaya, K., & Kaushal, R. (2023). Evaluation of Vidarigandhadi Gana of Sushruta Samhita. *World Journal of Pharmaceutical Research*, 12(5), 27609. <https://doi.org/10.20959/wjpr20235-27609>
8. Dipti, S., Sharma, P., et al. (2020). Vidarigandhadi Gana: Clinical indications and pharmacological basis. *Journal of Natural and Ayurvedic Medicine*, 4(2), 262. <https://doi.org/10.23880/jonam-16000262>
9. Rabb, U. N. (2023). Acharya Sushrutokta Gana and their pharmacological actions. *Journal of Ayurveda and Holistic Medicine*, 11(2), 672. <https://doi.org/10.70066/jahm.v11i2.672>
10. Gaikwad, M. S. (2026). Shalya tantra in Sushruta Samhita: A classical and contemporary review. *Ayurveda Journal of Advanced Sciences*, 12(6), 175–184.
11. Yadav, V., Tuli, A., Choudhary, K., Bhardwaj, A., Chauhan, R., & Sharma, J. (2021). Surgical procedures in Sushruta Samhita and its relevance in modern surgery. *Ayushdhara*, 8(4), 114–122.
12. Loukas, M., Lanteri, A., Ferrauola, J., Tubbs, R. S., Maharaja, G., Shojia, M. M., et al. (2010). Anatomy in ancient India: A focus on the Sushruta Samhita. *Journal of Anatomy*, 217(6), 646–650.
13. Sabharwal, P., & Jidani, S. (2024). A pragmatic comprehension of scientific and classical aspects of Rachana Sharir—A systematic review. *Future Health*, 2(3), 133–137. https://doi.org/10.25259/FH_34_2024
14. Dave, T., Habte, A., Vora, V., Sheikh, M. Q., Sanker, V., & Gopal, S. V. (2024). Sushruta: The father of Indian surgical history. *Plastic and Reconstructive Surgery—Global Open*, 12(4), e5715. <https://doi.org/10.1097/GOX.0000000000005715>
15. Gandhi, M. A., & Patil, B. K. (2024). Sushruta: The father of surgery and ancient medical innovations. *Cureus*.
16. Singh, M., Sharma, S., Sharma, S., & Sharma, R. (2019). A review article on surgical concepts of Acharya Sushruta. *Environment Conservation Journal*, 20(8), 109–114. <https://doi.org/10.36953/ECJ.2019.1008.1217>
17. Singh, V. (2017). Sushruta: The father of surgery. *National Journal of Maxillofacial Surgery*, 8(1), 1–3. <https://doi.org/10.5005/jp-journals-10015-1777>

.4103/njms.njms_33_17

18. Sharma, P. V. (2001). Sushruta Samhita with English translation. Chaukhamba Orientalia.
19. Aggarwal, B. B., & Harikumar, K. B. (2009). Potential therapeutic effects of curcumin, the anti-inflammatory agent, against chronic diseases. The International Journal of Biochemistry & Cell Biology, 41(1), 40–59. <https://doi.org/10.1016/j.biocel.2008.06.010>
20. Singh, R. H. (2011). Exploring the phytochemistry of classical Ayurvedic formulations. Indian Journal of Traditional Knowledge, 10(4), 577–586.
21. Patwardhan, B., Vaidya, A. D. B., & Chorghade, M. (2004). Ayurveda and natural products drug discovery. Current Science, 86(6), 789–799.
22. Mukherjee, P. K., et al. (2017). Phytochemical and pharmacological basis of Ayurvedic formulations. Phytotherapy Research, 31(1), 1–15. <https://doi.org/10.1002/ptr.5736>
23. Celsus, A. C. (1938). De medicina (Vol. III, Books 7–8; W. G. Spencer, Trans.). William Heinemann.
24. Breasted, J. H. (1930). The Edwin Smith surgical papyrus. University of Chicago Press.
25. Adams, F. (Trans.). (1849). The genuine works of Hippocrates. Sydenham Society.