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AYURVEDIC SURGERY FROM SUSHRUTA TO THE MODERN ERA: TRADITIONAL FOUNDATIONS AND EMERGING PERSPECTIVES IN INTEGRATIVE SURGICAL CARE

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ABSTRACT

Ayurvedic surgery, designated Shalya Tantra constitutes one of the eight classical limbs of *Ayurveda* and represents one of antiquity's most systematised surgical traditions. The *Sushruta Samhita*, compiled by *Acharya Sushruta* circa 600 BCE, documents over 300 operative procedures, 121 surgical instruments, and pioneering techniques in rhinoplasty, wound management, cataract couching, and fracture care. This review traces the historical evolution of Ayurvedic surgical practice from Vedic roots through medieval consolidation, colonial-era suppression, post-independence revival, and the contemporary phase of evidence based integration with modern allopathic surgery. A landmark regulatory milestone the 2020 Central Council of Indian Medicine (CCIM, now NCISM) gazette notification formally authorises MS *(Ayurveda)* graduates in *Shalya Tantra* and *Shalakya Tantra* to perform 39 general surgical and 19 ENT/ophthalmology/oro-dental procedures independently after structured training. The review synthesises classical foundations, surgical instrumentation, parasurgical techniques, wound classification systems, regulatory frameworks, clinical evidence, ethical dimensions, and future directions, advocating rigorous evidence-driven integration to deliver patient-centred, cost-effective, and culturally sensitive surgical care.

KEYWORDS: *Agnikarma*, integrative surgery, *Ksharasutra*, NCISM notification 2020, rhinoplasty, *Shalya Tantra, Sushruta Samhita, Vrana Ropana*

INTRODUCTION

Shalya Tantra is one of the eight classical limbs *(Ashtanga) of Ayurveda,* dedicated to the science and art of surgery, trauma management, and the removal of *Shalya* (foreign bodies or entities causing pain, such as arrows, tumours, calculi, or parasites). The term derives from *Shal* (to pierce or cause pain) and *Tantra* (a systematic technical discipline). In *Ayurvedic* philosophy, surgery is not merely a mechanical intervention but a holistic therapeutic modality employed when medicines, diet, and lifestyle measures have failed to restore equilibrium among the *Dosha* (biological humours: *Vata, Pitta, Kapha), Dhatu* (seven body tissues), *Mala* (metabolic wastes), and *Agni* (metabolic fire). It emphasises the surgeon's responsibility to align physical repair with the mental, emotional, and spiritual well-being of the patient, guided by a thorough appreciation of individual *Prakriti* (constitution) and *Vikruti* (pathological deviation from constitution).[1,37]

The cornerstone text of Shalya Tantra is the Sushruta Samhita, attributed to *Acharya Sushruta* of *Varanasi (Kashi),* approximately the 6th century BCE. Often described as the 'Father of Surgery' and 'Father of Plastic Surgery,' Sushruta compiled and systematised knowledge from the earlier *Vedic* traditions, the *Atharvaveda* surgical corpus, and his own extensive clinical practice. The text, subsequently redacted and enriched by scholars *Nagarjuna* and *Dalhana,* comprises six major sections *(Sthana): Sutra* (general principles), *Nidana* (pathology), *Sharira* (anatomy and embryology), *Chikitsa* (therapeutics), *Kalpa* (toxicology), and *Uttara* (supplementary topics). It documents over 1,120 disease conditions, describes 700 medicinal plants, and provides an encyclopaedic surgical manual of unparalleled depth in ancient world literature.[1,7]

Despite its extraordinary antiquity, *Ayurvedic* surgery remained clinically active across millennia, surviving the colonial suppression of indigenous systems to be revived in post-independence India through the establishment of the AYUSH Ministry, the Central Council of Indian Medicine (CCIM, now the National Commission for Indian System of

Medicine, NCISM), and dedicated *Ayurvedic* universities. Contemporary interest has been further catalysed by the persistent limitations of modern colorectal, plastic, and reconstructive surgery in specific clinical domains; by global patient demand for integrative, culturally resonant, and cost-effective treatment options; and by the surgical infrastructure deficit that continues to disproportionately affect rural and tribal populations in India and the broader Global South.[2,3,23]

The Indian subcontinent's surgical access gap is stark: India performs approximately 143 surgical procedures per 100,000 population annually, against the Lancet Commission on Global Surgery minimum benchmark of 5,000 per 100,000, a deficit most severe in rural regions where Ayurvedic practitioners often constitute the primary and sometimes sole available surgical resource.[23] This public health reality provides the structural context within which the 2020 NCISM notification must be situated and evaluated.

This review aims to: (i) document the classical surgical contributions of Sushruta and their global legacy; (ii) describe Sushruta's systematic surgical instrumentation and training philosophy; (iii) present the *Vrana* (wound) classification system and its clinical relevance; (iv) trace the historical evolution of *Shalya Tantra* through its major phases; (v) examine the parasurgical procedures and their contemporary clinical evidence; (vi) analyse the 2020 NCISM regulatory notification and its implications for surgical access equity; and (vii) outline ethical considerations, integration challenges, and future research directions that will determine the global footprint of integrative *Ayurvedic* surgical care.

MATERIALS AND METHODS

This is a comprehensive narrative review and critical thematic synthesis. Primary sources include the Sushruta Samhita (with *Dalhana's* commentary and English translations by *Bhishagratna* KL and Sharma PV), the *Ashtanga Hridaya of Vagbhata,* the *Charaka Samhita,* and other canonical *Sanskrit* texts. Secondary sources encompass

peer-reviewed journals indexed in PubMed, Scopus, EMBASE, and the AYUSH Research Portal; historical analyses of Indian surgical practice; published clinical trials and systematic reviews on integrative Ayurvedic procedures; regulatory documents issued by NCISM and CCIM; and the Lancet Commission on Global Surgery reports.

Search terms included: 'Sushruta Samhita surgery,' *'Ksharasutra* RCT,' 'CCIM 2020 surgical notification,' '*Ayurvedic* rhinoplasty history,' '*Shalya Tantra* integrative,' *'Vrana Chikitsa* wound healing,' '*Kshara Karma* haemorrhoids,' *'Agnikarma* clinical trial,' and '*Raktamokshana* leech therapy.' Inclusion criteria encompassed peer-reviewed clinical studies with stated methodology, classical textual references with scholarly translation, systematic reviews, and regulatory documents from 1990 to 2025. Non-English abstracts without accessible full text, uncontrolled case series without stated inclusion criteria, and non-peer-reviewed commentary were excluded.

Study design

Narrative literature review with thematic synthesis, structured under: (a) classical surgical contributions and instrumentation; (b) wound classification; (c) historical evolution; (d) parasurgical methods and clinical evidence; (e) regulatory framework; and (f) integration challenges and future perspectives. *Ayurvedic* terms are italicised with English equivalents provided in parentheses on first use throughout the text. Quality of clinical studies was assessed using the Jadad scale for randomised controlled trials. All data were organised thematically.

RESULTS AND DISCUSSION

Classical surgical contributions of Sushruta

Sushruta classified all surgical operations into eight fundamental categories, designated *Ashtavidha Shastra Karma* (eight types of surgical procedures). This taxonomic framework remains the foundational schema of *Shalya Tantra* and its correspondence with modern surgical categories is presented in Table 1.

Table 1: Sushruta's Ashtavidha Shastra Karma (Eight Types of Surgical Operations) with Modern Equivalents

S.No	*Sanskrit Term*	English Meaning	Clinical Equivalent
1.	*Chedana*	Excision	Tumour excision, limb amputation, excision of neoplastic tissue
2.	*Bhedana*	Incision	Incision and drainage of abscesses, fasciotomy
3.	*Lekhana*	Scraping / scarification	Curettage, surgical debridement, skin dermabrasion
4.	*Vedhana*	Puncturing	Paracentesis, thoracocentesis, fine-needle aspiration
5.	*Eshana*	Probing / exploration	Fistula probing, sinus tract exploration, urethral sounding
6.	*Aharana*	Extraction	Foreign body removal, dental extraction, calculus removal
7.	*Visravana*	Evacuation / drainage	Abscess drainage, haematoma evacuation, empyema drainage
8.	*Sivana*	Suturing	Primary wound closure, bowel anastomosis, vascular repair

Surgical instrumentation: the Yantra and Shastra system

Sushruta designed 101 blunt instruments *(Yantra)* and 20 sharp instruments *(Shastra)*, totalling 121 precisely described surgical instruments fabricated from metals, wood, stone, and animal materials, often bio-mimetically shaped after the forms of natural objects beaks, claws, tusks, and leaf structures.[1,4] Each instrument was described in relation to its intended operative use, the technique of fabrication (including the grades of iron and copper alloys appropriate for each application), the method of sharpening using abrasive stones, sterilisation procedures (boiling in water and subsequent immersion in herbal oil solutions), and protocols for safe storage and transport. These

specifications demonstrate principles functionally equivalent to modern aseptic technique and sterile instrument maintenance, predating the systematic germ theory of Pasteur and Koch by over two and a half millennia.[4] Table 5 presents the major instrument categories.

Table 5: Sushruta's Surgical Instrument Categories — Yantra and Shastra

S.No	Instrument Category	*Sanskrit Designation*	Description & Modern Analogue
1.	Blunt instruments	*Yantra*	Forceps (Sandamsha), tubes (Nadi), sounds (Shalaka); analogous to retractors, specula, probes
2.	Sharp instruments	*Shastra*	20 subtypes including scalpel (Mandalagra), scissors (Kartarika), trocar (Vrdhipatra); analogous to modern surgical blades
3.	Ligature materials	*Bandhana Dravya*	Hemp, silk, bark fibres, animal sinew; precursor to modern suture materials
4.	Cauterising agents	*Agnikarma Upakarana*	Five-metal rod (Panchadhatu Shalaka), charcoal, medicated wicks; analogous to electrocautery, chemical cauterisation

Wound classification: the Vrana system

Sushruta's comprehensive classification of wounds and surgical conditions, the *Vrana* (wound) system, encompasses over 60 distinct wound types categorised by aetiology, morphology, degree of contamination, stage of healing, and the *Dosha* primarily responsible for pathological tissue change. This classification served both diagnostic and prognostic functions, informing the selection of wound management strategy debridement (*Shodhana*), healing-promotion *(Ropana*), or surgical repair *(Sivana)*. Six sequential stages of wound healing *(Vrana Vastu)* were delineated, with distinct treatment objectives assigned to each stage a schema that parallels the contemporary wound healing model of haemostasis, inflammation, proliferation, and remodelling described in modern surgical pathophysiology.[1,8] Table 4 presents the principal wound and surgical condition categories.

Table 4: *Sushruta's Vrana* (Wound and Surgical Condition) Classification with Modern Analogues

S.No	*Wound Type (Vrana)*	Classical Description	Modern Analogy
1.	*Sadyovrana*	Fresh traumatic wound	Acute laceration, post-surgical incision
2.	*Dushta Vrana*	Infected / contaminated wound	Chronic infected ulcer, abscess cavity
3.	*Nadi Vrana*	Sinus or fistulous wound with winding tract	Fistula-in-ano, enterocutaneous fistula, pilonidal sinus
4.	*Bhagandara*	Perineal fistula with multiple openings	Complex fistula-in-ano, horseshoe abscess fistula
5.	*Arsha*	Pile mass / haemorrhoidal tissue	Internal / external haemorrhoids Grades I–IV
6.	*Granthi*	Knotted / circumscribed swelling	Cyst, fibroma, benign tumour, lymph node enlargement

Pioneering procedures and global legacy

The most celebrated and historically documented contribution of Sushruta is *Nasa Sandhan* (nasal reconstruction rhinoplasty). For noses amputated as judicial punishment or through traumatic injury, *Sushruta* described a forehead or cheek pedicle flap technique of remarkable sophistication: a leaf template matched to the anatomical dimensions of the contralateral nasal ala ensured proportional shape, hollow bamboo tubes were inserted into the reconstructed nostrils to preserve patency and prevent scarring contracture, and graduated herbal dressings incorporating *Madhu* (honey) and *Ghrita* (ghee) promoted wound healing and minimised infection.[5,13]

This technique was documented in the British medical literature by surgeons stationed in Pune in the Gentleman's Magazine in 1794, describing its practice by a *Kooma* (tile-maker by caste) practitioner. This report directly influenced the Branca family of Sicily (15th century) and inspired Joseph Carpue's landmark 1814 European rhinoplasty case, which is widely recognised as the founding event of modern reconstructive nasal surgery.[5,6] The Indian forehead flap with modifications remains a standard surgical option in contemporary nasal reconstruction following oncological or traumatic loss of the nose.

In ophthalmology, Sushruta described *Jabamukhi Salaka* a couching technique for cataract management employing a curved needle to displace the opacified lens posteriorly into the vitreous, restoring functional vision. While not an extraction technique, this represents the earliest documented systematic approach to cataract surgery, predating European couching descriptions by many centuries. He also detailed treatments for pterygium *(Arma),* trichiasis *(Pakshma Kopa)*, and lacrimal fistula *(Ashrusrava).*[1,7]

In orthopaedics *(Bhagna Chikitsa)*, a 12-type fracture classification system was codified, with detailed descriptions of closed reduction, immobilisation using bamboo-bark splints *(Nalika Bandha)*, traction techniques, and a staged rehabilitation protocol to restore functional range of motion a systematic approach to fracture management not replicated with equivalent clinical detail in European surgical literature until the 18th century. Urological contributions included *Ashmari Bhedana* (perineal lithotomy for vesical calculi) and a description of intestinal wound closure using large black ants' mandibles for fine tissue approximation an innovation in biological suture devices whose antimicrobial properties have been validated by modern biochemical analysis.[1,7]

Wound management: pharmacosurgical integration

For wound management *(Vrana Chikitsa)*, Sushruta codified a multi-stage pharmacosurgical protocol: initial debridement *(Shodhana)* using a medicated paste *(Kalka)* of astringent and antimicrobial herbs; antiseptic irrigation with decoctions of *Kashaya* drugs; application of healing-promoting herbal pastes incorporating *Haridra* (Curcuma longa), *Nimba* (Azadirachta indica), *Madhuyashti* (Glycyrrhiza glabra), and

Lodhra (Symplocos racemosa); and protective dressings using ghee-honey combinations, whose hygroscopic, antimicrobial, and moisture-retentive properties are now well characterised in the modern wound care literature. The curcuminoid compounds of *Haridra* have been demonstrated in contemporary pharmacological research to modulate NF-κB-mediated inflammatory pathways, promote fibroblast proliferation, and exhibit broad-spectrum antimicrobial and antifungal activity an evidence base that validates Sushruta's empirical clinical observations by over two millennia.[8,28]

Anaesthesia, surgical training, and the ideal surgeon

Sushruta documented herbal sedative and analgesic preparations including *Sura* (fermented grain wine), *Vijaya* (Cannabis sativa the active compounds of which are now pharmacologically characterised as CB1/CB2 receptor agonists producing analgesia and sedation), *Dhattura* (Datura stramonium source of anticholinergic alkaloids including scopolamine and hyoscyamine that produce sedation and analgesia), and combination preparations for pain control during surgical procedures.[9] These represent among the earliest systematically documented concepts of surgical anaesthesia in world medical history.

The prescribed training system for the *Ayurvedic* surgeon demanded a structured six-year apprenticeship under a qualified *Vaidya* (physician-surgeon), incorporating cadaver dissection performed with ritual respect *(Mritak Sharira Adhyayana)*, and progressive simulation practice on botanical models gourds for incision technique, leather bags for suturing, and dead animals for organ manipulation before proceeding to supervised operative practice on living patients.[1,9] The character specification for the ideal surgeon *(Dwividha Chikitsa Yoga)* demanded: steady and uncramped hands *(Achalahasta)*, keen intelligence *(Dridha Manasa)*, moral courage *(Shura),* compassion for the patient *(Karuna),* and comprehensive constitutional knowledge for pre-operative prognosis a formulation that resonates directly with modern surgical competency frameworks emphasising technical skill, cognitive ability, ethical conduct, and patient empathy.[1,25]

Historical evolution: from Vedic origins to colonial era

The Vedic origins of Ayurvedic surgery are traceable to the *Atharvaveda* (c. 1500 BCE), which contains hymns and formulae associated with wound healing, limb prosthetics

(the iron leg *Ayas Pada* granted to the warrior *Vishpala)*, and surgical prayers. The transition from Vedic ritualistic healing to rational systematised clinical surgery is embodied in the *Sushruta Samhita* itself, which explicitly distances the Shalya tradition from purely ritual approaches, grounding it in empirical observation, anatomical knowledge acquired through cadaver study, and clinical reasoning.[9,10]

The post-*Sushruta* tradition was substantially consolidated through the *Ashtanga Hridaya* and *Ashtanga Sangraha* of *Vagbhata* (7th century CE), which synthesised and elaborated the surgical knowledge of the classical period within a unified Ayurvedic system. Buddhist monastic hospitals the *Mahavihara* institutions at *Nalanda, Vikramashila*, and *Taxila* served as advanced surgical centres with documented facilities for operative care, extending *Ayurvedic* practice across South and Southeast Asia. Medieval India saw productive intellectual exchange with Unani (Greco-Arabic) medicine through the sustained contact facilitated by the Mughal court, particularly enriching the pharmacosurgical material medica and the cauterisation techniques of both traditions.[10,11]

The British colonial period (18th–20th centuries) precipitated significant institutional decline in *Shalya Tantra* through preferential state patronage of Western allopathic medicine, systematic withdrawal of public financial support for *Ayurvedic* institutions, and the formal exclusion of indigenous medical systems from official curricula mandated by colonial medical governance. However, the 1794 documentation in the Gentleman's Magazine of the Indian rhinoplasty technique by British military surgeons observed being performed using classical *Sushruta Samhita* methodology by a traditional *Kooma* practitioner near Pune paradoxically catalysed the global diffusion of the most celebrated of all *Ayurvedic* surgical innovations. Traditional surgical knowledge continued through unbroken lineages of regional folk surgical practitioners, particularly in the management of anorectal conditions, fistulae, and external growths.[5,6,11]

Post-independence revival and institutional development

Following Indian independence in 1947, the establishment of the All India Institute of Ayurveda, the Central Council of Indian Medicine (CCIM), and dedicated *Ayurvedic* universities facilitated systematic institutional revival. Research institutions including the Central Council for Research in *Ayurvedic* Sciences (CCRAS) undertook the validation of traditional methods through modern experimental and clinical

methodologies, producing the foundational evidence base for the parasurgical procedures that now form the core of integrative *Ayurvedic* surgical practice. The AYUSH Ministry, formally constituted in 2014, consolidated governmental commitment to evidence-based integration and substantially increased the research funding available for rigorous clinical trials.[2,3,36]

Parasurgical procedures: mechanisms and clinical evidence

The *Anushastra Karma* (parasurgical procedures) of *Ayurveda* represent a clinically distinctive group of minimally invasive interventions that deploy chemical, thermal, or biological agents rather than sharp metallic instruments as the primary operative mechanism. These procedures occupy a unique therapeutic niche at the intersection of pharmacology, surgery, and regenerative medicine, offering clinically relevant alternatives or adjuncts in specific colorectal, dermatological, and musculoskeletal conditions. Table 2 summarises the four principal techniques with their operative mechanisms and available clinical evidence.[37]

Table 2: *Ayurvedic* Parasurgical Procedures — Mechanisms and Clinical Evidence

S.No	*Procedure*	Mechanism	Clinical Application & Evidence
1.	*Kshara Karma*	Alkaline cauterisation (pH >9.5); proteolytic tissue dissolution	Haemorrhoids Gr I–III; RCT: comparable to rubber-band ligation with lower pain scores [18]
2.	*Ksharasutra*	Medicated thread; simultaneous chemical cutting, cauterisation, and drainage over 7–10 days per cm	Fistula-in-ano; ICMR RCT (n=512): recurrence 3.33% vs 11.42% (surgery); meta-analysis OR 0.27 (95% CI 0.14–0.51) [14,19]
3.	*Agnikarma*	Thermal cauterisation via heated metal probe (Shalaka) or medicated substances (Panchadhatu)	Haemorrhoids Gr I–II, musculoskeletal pain syndromes; RCT: superior prolapse reduction at 6 months vs sclerotherapy [20]
4.	*Raktamokshana*	Controlled bloodletting; leech therapy (Jalaukavacharana) or venesection to reduce inflammatory mediators	Varicosities, inflammatory vascular conditions; anti-inflammatory via hirudin, destabilase, hyaluronidase [21]

Ksharasutra therapy for fistula-in-ano has achieved the most robust evidence base among all Ayurvedic surgical procedures. The landmark Indian Council of Medical Research (ICMR) multi-centre randomised controlled trial the largest single trial in the Ayurvedic surgical literature enrolled 512 patients across seven tertiary referral centres and documented a recurrence rate of 3.33% in the *Ksharasutra* arm versus 11.42% in the conventional fistulotomy arm at one-year follow-up, with statistically significant advantages in sphincter preservation and lower post-operative complication rates.[14] A subsequent meta-analysis by *Sharma* et al. covering nine comparative studies (n = 963 patients) confirmed a pooled recurrence odds ratio of 0.27 (95% CI 0.14–0.51) favouring *Ksharasutra* over conventional surgical management.[19]

The graduated chemical cutting mechanism of *Ksharasutra* averaging one centimetre of fistulous tract division per week allows simultaneous progressive fibrotic healing and sphincter reinforcement during the division process. This mechanism directly addresses the primary surgical risk of standard fistulotomy irreversible faecal incontinence through division of the external sphincter complex by replacing the acute mechanical division with a slow, chemically mediated process that preserves functional sphincter integrity. Functional equivalence with the contemporary long cutting seton technique (a modern surgical adaptation of the same biological principle) has been documented across comparative studies, with the *Ayurvedic* approach achieving the process chemically rather than mechanically and with significantly lower patient-reported discomfort scores during the treatment period.[19,20]

The 2020 NCISM regulatory notification

On 20 November 2020, the Central Council of Indian Medicine issued a gazette notification amending the Postgraduate Ayurveda Education Regulations 2016, explicitly adding 'General Surgery' to the MS *Shalya Tantra* curriculum and authorising graduates to independently perform specified modern surgical procedures after completing structured training and supervised operative experience in attached allopathic hospitals. The notification covers 39 procedures under *Shalya Tantra* and 19 procedures under *Shalakya Tantra* (ENT, ophthalmology, and oro-dental surgery).[22,36]

Table 3 presents a representative selection of the permitted procedures alongside their Ayurvedic classical correlates, demonstrating the philosophical and technical continuity between the ancient Sushruta Samhita descriptions and the contemporary procedures that MS *(Ayurved)* graduates are now authorised to perform.

Table 3: Selected NCISM 2020 Permitted Procedures with Ayurvedic Classical Correlates

S.No	Procedure	*Branch*	*Ayurvedic Classical Correlate*
1.	Debridement and wound management	*Shalya Tantra*	*Vrana Chikitsa (Shodhana + Ropana)*
2.	Incision and drainage of abscesses	*Shalya Tantra*	*Bhedana Karma*
3.	Excision of cysts, lipoma, fibroma, benign tumours	*Shalya Tantra*	*Chedana Karma*
4.	All types of skin grafting	*Shalya Tantra*	*Tvak Sandhan (skin reconstruction)*
5.	Traumatic wound suturing, haemostasis	*Shalya Tantra*	*Sivana Karma*
6.	Foreign body removal (superficial, non-vital)	*Shalya Tantra*	*Aharana / Eshana Karma*
7.	Cataract surgery (phacoemulsification)	*Shalakya Tantra*	*Timira / Linganasha Chikitsa*
8.	Functional endoscopic sinus surgery (FESS)	*Shalakya Tantra*	*Nasagata Roga Chikitsa*
9.	Dental extractions and root canal treatment	*Shalakya Tantra*	*Dantamula Chikitsa*
10.	Amputation for gangrene	*Shalya Tantra*	*Chedana for Visha-Shotha (gangrenous limb)*

The rationale for this regulatory integration is compelling from a public health equity perspective. India's surgical infrastructure deficit estimated at 143 surgical procedures per 100,000 population annually against the Lancet Commission on Global Surgery minimum benchmark of 5,000 is most acute in rural and tribal regions where *Ayurvedic* practitioners frequently represent the primary and only accessible surgical resource for millions of citizens.[23] Authorising trained *Ayurvedic* surgeons to perform clearly defined procedures directly addresses this equity gap while preserving the holistic, constitution-based care philosophy that characterises the *Ayurvedic* paradigm an approach that may offer superior acceptability and treatment adherence among patient populations with deep cultural familiarity with the *Vaidya* (traditional physician) relationship model.

Integration challenges and ethical considerations

The 2020 notification generated significant and legitimate debate within biomedical surgical communities, centred on concerns regarding training adequacy, patient safety, medicolegal accountability, and evidence standardisation. These concerns require systematic and transparent institutional response rather than dismissal. Key structural challenges include: substantial disparities in surgical simulation infrastructure across the 258 *Ayurvedic* colleges in India; the limited availability of faculty trained and credentialled in both classical *Ayurvedic* methods and modern surgical technique; the absence of standardised competency assessment frameworks and certification mechanisms; and the imperative need for clear medicolegal protocols delineating professional liability for MS *(Ayurved)* practitioners performing procedures listed in the NCISM notification.[24]

From an ethical standpoint, responsible integration requires absolute prioritisation of patient informed consent a principle explicitly enshrined in the Sushruta Samhita's doctrine of *Anujna* (formal informed consent obtained from the patient and family before any operative intervention) alongside transparent communication of the evidence base specific to each procedure, realistic outcome expectations relative to allopathic alternatives, and accessible mechanisms for timely escalation to tertiary allopathic care when indicated. The Sushruta Samhita itself codified contraindications

to surgery (*Asadhya Vrana* wounds or conditions deemed unresectable), reflecting the classical tradition's own recognition that surgical restraint is as clinically important as operative skill.[1,25]

Inter-system clinical collaboration with Ayurvedic and allopathic surgeons functioning within shared governance frameworks, joint morbidity and mortality review meetings, and unified patient safety reporting systems represents the optimal institutional model for safe and evidence-accountable integration. This model is already operational in several teaching hospitals in Karnataka, Kerala, and Maharashtra, where integrative surgical wards manage conditions such as anorectal fistulae, pilonidal sinus, and benign anorectal growths using a protocol that selects between *Ksharasutra,* conventional fistulotomy, or combined management based on fistula classification, sphincter status, and patient preference.[16,24]

Future perspectives

Several priority areas will define the trajectory of integrative *Ayurvedic* surgery over the coming decade. Bioactive characterisation of classical herbal wound dressings including curcumin from *Haridra,* azadirachtin from Nimba, allicin from Rasona (*Allium sativum)*, and tannins from *Lodhra* offers tractable translational opportunities for evidence-based pharmaceutical wound care product development that harnesses the *Ayurvedic* pharmacological tradition within a regulatory framework acceptable to global health authorities.[8,27,28]

Multi-centre randomised controlled trials comparing *Ksharasutra* with video-assisted anal fistula treatment (VAAFT) and ligation of intersphincteric fistula tract (LIFT) are urgently required to position the *Ayurvedic* intervention within the contemporary algorithmic management of complex anal fistulae. Standardisation of *Kshara* preparations with defined pH, titratable alkalinity, standardised phytochemical profiles, and consistent batch-to-batch reproducibility is an essential prerequisite for multi-centre trial design and for potential regulatory approval as a defined medical device. Current variation in *Kshara* preparations across manufacturing sites represents the primary methodological obstacle to pooling of trial data.[19,26]

Artificial intelligence-assisted analysis of classical *Ayurvedic* surgical texts applying natural language processing to *Sanskrit* computational archives could systematically identify undocumented procedural analogues and pharmacological correlates that have not yet been explored through modern experimental approaches. Biomaterial science offers significant potential for the development of novel bioresorbable suture materials and wound dressing platforms based on classical *Ksharasutra* coating chemistry, with applications beyond anorectal surgery to chronic wound management, tumour bed reconstruction, and regenerative dermatology.[27,28] Hybrid operating theatres within designated integrative *Ayurvedic* teaching hospitals, combining modern intraoperative imaging, laparoscopic access, and anaesthetic monitoring with *Ayurvedic* procedural expertise and post-operative *Panchakarma* based rehabilitation, represent the institutional model most likely to generate the high-quality evidence required to determine the long-term global footprint of integrative surgical care.

CONCLUSION

The journey of *Ayurvedic* surgery from Sushruta's visionary 6th-century BCE codification of operative technique, instrument design, wound classification, and surgical training to the 2020 NCISM regulatory notification exemplifies an extraordinary narrative of intellectual resilience and clinical adaptability across two and a half millennia. The *Sushruta Samhita* established surgical principles systematic wound classification, tissue-respecting operative technique, antiseptic herbal wound dressings, graduated anaesthetic preparation, mandatory informed consent, and structured progressive surgical training that preceded their Western counterparts by centuries and continue to offer clinically relevant insight into domains where modern surgery acknowledges its limitations.

Parasurgical techniques, particularly *Ksharasutra* and *Kshara Karma*, have advanced from classical textual description to multi-centre randomised clinical validation, demonstrating efficacy, sphincter-preserving advantage, and cost-effectiveness that position them favourably against conventional surgical alternatives in well-defined patient populations. The 2020 NCISM notification represents a regulatory acknowledgement of this evolving evidence base and a structural commitment to addressing India's profound surgical access inequity through evidence-informed

deployment of *Ayurvedic* surgical expertise a deployment that the classical tradition itself would recognise as consistent with its foundational tenet of *Sarve Bhavantu Sukhinah* (may all beings be well).

Realising the full potential of this integration demands rigorous prospective evidence generation, standardised and externally validated training frameworks, robust competency assessment mechanisms, transparent medicolegal governance, accessible escalation pathways, and sustained inter-system institutional collaboration. This synthesis advocates continued investment at the level of policy, infrastructure, curriculum, and research to honour the ancient wisdom of Shalya Tantra while advancing the scientific evidence base required for its responsible, patient-centred, and globally relevant application in the service of surgical equity.

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