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RESEARCH ARTICLE

YOGYA IN *SHALYA TANTRA*: REVISITING AN ANCIENT SIMULATION-BASED PARADIGM OF SURGICAL SKILL ACQUISITION AND ITS RELEVANCE TO CONTEMPORARY SURGICAL EDUCATION

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ABSTRACT

Background: Surgical competence in *Ayurveda* has traditionally been understood as the integration of theoretical erudition (*Shastra Jnana*) with practical dexterity (*Kriya Kaushalya*). *Acharya Sushruta*, regarded as the father of surgery, insisted that no practitioner should attempt an operative procedure on a living patient without prior training on substitute models. This preparatory training methodology, described in the *Sushruta Samhita* under the term *Yogya*, constitutes one of the earliest documented frameworks of simulation-based surgical education in world medical history. **Objective:** To critically review the classical concept of *Yogya* as described in *Shalya Tantra* and to correlate its principles, materials, and pedagogical structure with modern simulation-based surgical training methodologies. **Materials and Methods:** A narrative literary review was conducted using classical *Ayurvedic* texts, commentaries, and contemporary peer-reviewed literature on simulation-based medical education. Thematic comparison was performed between *Yogya* practice models and modern simulation modalities such as mannequins, virtual-reality simulators, and cadaveric training. **Results:** The classical description of *Yogya* identifies specific organic and inorganic substitute materials — such as pumpkins, bottle gourds, leather bags, lotus stems, and worm-eaten wood — each selected for its biomechanical resemblance to particular human tissues, enabling trainees to rehearse core operative actions (*Shastrakarma*) including *Chedana*, *Bhedana*, *Lekhana*, *Vedhana*, *Eshana*, and *Aharana* before clinical application. **Conclusion:** The pedagogical logic underlying *Yogya* - graded, repetitive, low-risk skill rehearsal prior to patient contact - anticipates, by more than two millennia, the core rationale of present-day simulation-based surgical curricula. Structured revival of *Yogya*-based training, integrated with modern simulation technology, offers a cost-effective and culturally rooted supplement to surgical pedagogy, particularly in resource-constrained settings.

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INTRODUCTION

Surgery, by its very nature, is a discipline in which cognitive knowledge alone is insufficient; it demands the concurrent cultivation of manual skill, spatial judgment, and psychomotor confidence. Ancient *Ayurvedic* surgeons recognized this duality long before it was formally articulated in modern medical pedagogy. *Shalya Tantra*, one of the eight clinical specialties (*Ashtanga Ayurveda*) enumerated in classical texts, is devoted entirely to operative intervention, and its foremost exponent, *Acharya Sushruta*, laid down an elaborate curriculum for training a surgeon (*Shalya Chikitsaka*) that extended well beyond textual study. The *Sushruta Samhita*, compiled in the *Sutrasthana*, explicitly cautions against the premature handling of surgical instruments on human beings. Instead, it prescribes a structured sequence of preparatory exercises collectively termed *Yogya* - literally, "that which is fit for practice" or "that which renders one competent through repeated exercise." The underlying premise is unambiguous: technical dexterity is a trainable, incremental skill that must be rehearsed on inanimate or non-human substrates until a threshold of competence, precision, and confidence is achieved. In the intervening centuries, formal surgical education largely shifted toward direct apprenticeship at the bedside and, more recently, toward operating-room exposure supplemented by didactic teaching. However, growing concerns regarding patient safety, medico-legal accountability, and the ethical implications of a novice's "learning curve" occurring on live patients have driven a resurgence of simulation-based education in the twenty-first century. Professional bodies now mandate structured simulation

training - using mannequins, bench-top models, virtual-reality platforms, and cadaveric dissection - before trainees are permitted independent operative responsibility. It is in this context that the classical concept of *Yogya* acquires renewed academic significance. Far from being a historical curiosity, *Yogya* represents a remarkably systematic, materials-based simulation curriculum that anticipated core principles now considered indispensable to modern surgical training. This article undertakes a focused review of *Yogya* as described in *Shalya Tantra*, elaborates upon its constituent practice models, and draws a structured correlation with contemporary simulation-based surgical education, with a view to informing integrative pedagogical approaches.

Aims and Objectives

- To review and elaborate the classical concept of *Yogya* as described in the *Sushruta Samhita*.
- To enumerate the various *Yogya* practice models and correlate each with the specific surgical skill it was designed to cultivate.
- To compare the pedagogical framework of *Yogya* with contemporary simulation-based surgical training modalities.
- To assess the continued relevance, strengths, and limitations of *Yogya*-based training in the context of modern surgical curricula.

MATERIALS AND METHODS

This article is structured as a narrative literary review. Primary classical source material was drawn from the *Sutrasthana* of the *Sushruta Samhita*, along with available commentarial literature (*Nibandha*), including the *Nibandha Sangraha* commentary of *Dalhana*. Secondary sources included published review articles, textbooks on the history of *Ayurvedic* surgery, and peer-reviewed literature on simulation-based medical education indexed in standard biomedical databases. Material was drawn from the following categories:

- *Ayurvedic* compendia (*Brihatrayi*) and available commentaries dealing with *Shalya Tantra*.
- Peer-reviewed contemporary literature on simulation-based surgical and medical education.
- Review articles and editorials addressing surgical skill acquisition, learning curves, and patient safety.

Thematic content extracted from classical descriptions of *Yogya* was tabulated and mapped against corresponding modern simulation modalities to identify areas of conceptual convergence, and a comparative and narrative synthesis was subsequently prepared.

Conceptual Review of Yogya

[1]The Sanskrit term *Yogya* derives from the root *"yuj"*, meaning to join, apply, or engage; in this context it denotes "that which is fit for practice" or "that which is trained through disciplined exercise." In *Shalya Tantra*, *Yogya* specifically refers to the deliberate practice of operative maneuvers upon substitute materials selected for their tactile, textural, and mechanical similarity to living human tissue.

The classical rationale is explicitly pedagogical. *Acharya Sushruta* holds that a surgeon who has not attained proficiency through preparatory exercise is liable to falter at the critical moment of operating on a patient, endangering both the outcome of the procedure and the trust reposed in the physician. Practice on *Yogya* models was therefore considered an obligatory, non-negotiable stage in surgical training - to be undertaken only after the trainee had acquired adequate theoretical grounding (*Shastra Jnana*) and had observed procedures demonstrated by a qualified preceptor (*Guru*).

The eight fundamental operative maneuvers (*Shastrakarma* or *Ashta-vidha Shastrakarma*) described in *Shalya Tantra*-namely *Chedana* (excision), *Bhedana* (incision), *Lekhana* (scraping/scarification), *Vedhana* (puncturing), *Eshana* (probing/exploration), *Aharana* (extraction), *Visravana* (drainage), and *Sivana* (suturing)-form the operative vocabulary of the *Ayurvedic* surgeon. *Yogya* was designed to allow deliberate, repeated rehearsal of each of these maneuvers, so that the requisite hand-eye coordination, pressure calibration, and instrument control could be internalized before clinical application.

Practice Models of Yogya and Their Correlated Surgical Skills

[1]Classical texts describe specific substitute materials for the rehearsal of each surgical maneuver. The selection of each material was not arbitrary; rather, it reflects a discerning appreciation of the biomechanical properties- resistance, elasticity, fibrous architecture, and fluid content- that most closely approximate the corresponding human tissue or surgical scenario. These are summarized in Table 1 and elaborated thereafter.

Surgical Maneuver (Shastrakarma)	Yogya Material Prescribed	Rationale / Tissue Correlate
Chedana (Excision)	Pumpkin (Alabu), bottle gourd, other soft-rind vegetables	Firm outer rind with a soft, homogeneous core simulates cutting through skin and underlying soft tissue with controlled depth.
Bhedana (Incision)	Leather bags/bladders filled with fluid or mud	Taut, fluid-filled surface mimics the resistance and "give" of an abscess wall or cystic swelling during incision and drainage.
Lekhana (Scraping)	Hairy animal skin / rough natural surfaces	Textured surface trains the trainee to apply light, even, superficial strokes without excessive depth, as in scarification procedures.
Vedhana (Puncturing)	Lotus stem (Bisa), animal bladder	Hollow, turgid structures simulate vessels and cavities, allowing rehearsal of controlled needle or trocar entry.
Eshana (Probing)	Worm-eaten (hollowed) wood	Irregular internal cavities replicate sinus tracts and fistulous passages, training tactile exploration with a probe.
Aharana (Extraction)	Fruits/vegetables containing embedded seeds	Embedded foreign bodies within pulp simulate the retrieval of foreign objects, calculi, or splinters from soft tissue.

In addition to the six maneuvers detailed above, later commentators extend the *Yogya* framework to include practice of *Sivana* (suturing) on cloth or hide, and *Visravana* (drainage) on fluid-filled bladders - reinforcing that the totality of the *Ashta-vidha Shastrakarma* was intended to be rehearsed through analogous substitute media before any instrument touched a patient. Pedagogical Importance of *Yogya* in Surgical Training

The classical insistence on *Yogya* reflects an early and sophisticated understanding of skill-based learning theory. Its importance may be summarized as follows:

- **Risk-free learning environment**: Errors committed during practice on inert or organic models carry no clinical consequence, permitting trainees to make and learn from mistakes safely.
- Development of manual dexterity and coordination**:** Repeated handling of instruments on resistant, textured, and irregular media builds fine motor control and instrument-tissue feedback sense.
- Facilitation of repetitive, deliberate practice:The models are inexpensive and freely available, permitting the high repetition volume that skill acquisition research identifies as essential to mastery.
- Building of psychological confidence:Rehearsed familiarity with the mechanics of a procedure reduces performance anxiety when the trainee eventually operates on a patient.
- Reduction of iatrogenic injury:A trainee who has already internalized correct technique is less likely to cause avoidable tissue trauma, hemorrhage, or procedural error.
- Improved downstream clinical outcomes:Cumulatively, these factors translate into safer, more precise, and more consistent surgical performance at the bedside.

The Yogya-Based Surgical Training Pathway

Classical surgical pedagogy in *Shalya Tantra* was not a single event but a graded, sequential pathway, moving the trainee systematically from cognitive learning to independent clinical competence. This pathway may be schematically represented as follows:

Theoretical Knowledge (Shastra Jnana)
↓
Demonstration by the Preceptor (Guru)
↓
Supervised Practice on Yogya Models (Fruits, Vegetables, Leather, Wood, Bladders)
↓
Repetitive, Deliberate Skill Training
↓
Development of Dexterity, Precision, and Instrument Control
↓
Confidence Building and Error Reduction
↓
Supervised Clinical Application on the Patient
↓
Improved Surgical Outcomes and Patient Safety

This stepwise progression - from cognitive understanding, through observation, to graded hands-on rehearsal and only then to supervised clinical practice - mirrors, in essential structure, the widely accepted modern instructional models for procedural skill acquisition, such as the "see one, practice on a simulator, do one" framework and stepwise mastery-learning curricula used in contemporary surgical residency training.
Correlation with Modern Simulation-Based Surgical Training
Contemporary surgical education has, over the past three decades, moved decisively toward simulation-based skill acquisition prior to patient contact. Commonly used modern modalities include:

- **Bench-top and mannequin-based models:** Anatomically contoured synthetic models used to rehearse suturing, incision, and basic operative steps.
- **Virtual reality (VR) and augmented reality (AR) simulators:** Computer-generated environments providing haptic feedback and objective performance metrics for laparoscopic and endoscopic procedures.
- **3D-printed patient-specific anatomical models:** Used increasingly for rehearsal of complex or rare procedures prior to actual surgery.
- **Cadaveric and animal-tissue dissection:** Offering high anatomical fidelity for advanced procedural training.

A structured comparison between the classical *Yogya* system and modern simulation-based training is presented in Table 2.

Yogya (Classical Ayurvedic Model)	Modern Simulation-Based Training
Utilizes freely available natural/organic materials (fruits, vegetables, wood, leather)	Utilizes synthetic, engineered, or digitally rendered models
Provides basic, low-fidelity tactile and textural simulation	Provides high-fidelity simulation with haptic and physiological feedback
Extremely low-cost, widely accessible, requiring no technology	Often expensive, requiring specialized equipment and infrastructure
Emphasizes unlimited, repetitive practice under a Guru's supervision	Structured skill laboratories with standardized, assessable curricula
Lacks objective performance metrics	Enables objective, quantifiable assessment of trainee performance

Viewed collectively, *Yogya* may reasonably be regarded as the earliest recorded systematic framework of simulation-based surgical training in medical history, predating modern surgical skill laboratories by well over two thousand years. While the materials and fidelity differ vastly, the underlying pedagogical philosophy - that competence must be rehearsed on a surrogate before it is exercised on a patient - is identical.

DISCUSSION

The classical description of *Yogya* reveals a nuanced understanding of surgical pedagogy that anticipates several principles now considered foundational in modern medical education literature. Contemporary evidence consistently demonstrates that simulation-based training reduces intraoperative errors, shortens the learning curve for novice operators, improves procedural accuracy, and enhances overall patient safety. *Acharya Sushruta*'s insistence on graded, hands-on rehearsal before clinical application reflects an intuitive grasp of what modern educational theory would later formalize as deliberate practice - repetitive, feedback-driven rehearsal directed at incremental skill refinement. Furthermore, the deliberate matching of substitute material to the biomechanical demands of a specific maneuver - pumpkin for excision, fluid-filled bladders for incision and drainage, hollowed wood for probing - demonstrates a task-specific, competency-based approach to training rather than generic, undifferentiated practice. This granularity of design is conceptually analogous to the modern principle of "part-task training," wherein a complex procedure is deconstructed into its component skills, each rehearsed individually before integration into the complete operative sequence. It is also notable that *Yogya* training was explicitly positioned within a broader mentorship structure, following theoretical instruction and direct demonstration by a *Guru*, and preceding supervised clinical exposure. This graduated, apprenticeship-embedded model parallels the stepwise entrustment frameworks - such as competency-based medical education and entrustable

professional activities - increasingly adopted in modern surgical residency training worldwide. Although *Yogya* naturally lacks the physiological realism, objective metrics, and technological sophistication of contemporary simulators, its core educational objective is identical: to ensure that competence, precision, and confidence are established before a trainee's hands are permitted upon a living patient. This convergence across two vastly different eras and technological contexts lends considerable credibility to the pedagogical soundness of the classical *Ayurvedic* approach to surgical training.

Limitations

- Classical *Yogya* models offer limited anatomical accuracy relative to human tissue and cannot replicate true three-dimensional surgical anatomy.
- They lack physiological responses such as bleeding, pulsation, or pain response, which are integral to real operative decision-making.
- They are unable to simulate complex, multi-step, or emergency surgical scenarios requiring rapid clinical judgment.
- No objective, quantifiable metric of trainee performance is described in the classical texts, limiting standardized assessment.

Despite these constraints, *Yogya* retains substantial value as a foundational, entry-level training tool, particularly for cultivating basic instrument handling and hand-eye coordination in early learners.

Future Scope and Integrative Potential: There exists considerable scope for integrating the philosophy of *Yogya* with modern simulation infrastructure, particularly in resource-limited teaching institutions. Low-cost, biologically derived *Yogya* models could be systematically incorporated as a preliminary, foundational tier of training - preceding exposure to costlier synthetic or virtual-reality simulators - within a tiered, competency-based surgical curriculum. Further prospective studies comparing trainee performance metrics following *Yogya*-based preparatory practice against standard training protocols would help generate objective evidence for such integration, and represent a promising direction for future research in *Ayurvedic* surgical pedagogy.

CONCLUSION

Yogya in *Shalya Tantra* represents a scientifically sound, methodologically structured, and remarkably prescient approach to surgical training, conceived well over two millennia before the formalization of simulation-based medical education. It underscores an enduring pedagogical truth - that practice must precede performance - a principle that today lies at the very core of modern surgical curricula worldwide. Thoughtful integration of *Yogya*'s time-tested, low-cost training philosophy with contemporary simulation technology holds genuine promise for strengthening surgical education, particularly in settings where access to advanced simulators remains limited, thereby uniting traditional wisdom with modern technological capability in the service of safer surgical care.

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