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Shalya Instruments and Their Dimensions According to Sharir Rachana: A Review

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Abstract

Background: Shalya Tantra, a key branch of Ayurveda, focuses on surgical procedures and the use of Shalya Yantras (surgical instruments). The Sushruta Samhita, a foundational text in Ayurveda, describes 101 blunt instruments (Yantras) and 20 sharp instruments (Shastras), designed with precision based on Sharir Rachana (anatomy). These instruments were developed with ergonomic principles to enhance efficiency, safety, and precision in surgical interventions**.**

Objective: This study explores the dimensions, ergonomics, and modern relevance of Ayurvedic surgical instruments as described in Sushruta Samhita, correlating their design with contemporary surgical tools**.**

Methodology: A detailed literature review of Ayurvedic texts was conducted, particularly focusing on the dimensions of instruments based on Anguli Pramana (finger measurement). Ergonomic principles such as grip control, weight distribution, biomechanics, and strain reduction were analyzed and correlated with modern surgical instruments.

Results: The study highlights the scientific rationale behind the dimensions of Shalya Yantras. Ayurvedic instruments were ergonomically crafted for: Precision and accuracy in surgical interventions, surgeon comfort and reduced hand fatigue, minimized trauma, reduced healing time, and enhanced patient safety, optimized design for efficiency in surgical procedures Additionally, a direct correlation with modern surgical instruments was identified, demonstrating Ayurveda's foresight in instrument design.

Conclusion: Sushruta's Shalya Yantras were not only designed based on anatomical principles but also incorporated ergonomic efficiency, aligning closely with modern surgical instrument design. By understanding and integrating these ancient ergonomic principles, modern surgical tools can be further refined for improved efficiency, precision, and safety in contemporary medicine. The relevance of Ayurvedic surgical knowledge continues to influence modern-day surgical advancements, bridging traditional wisdom with scientific innovation.

Keywords: *Anguli Pramana*, Ayurvedic Surgical Instruments, Ergonomics

1. Introduction

Shalya Tantra, one of the eight branches of Ayurveda, deals with surgical procedures, including the use of *Shalya Yantras* (surgical instruments). Ancient *Ayurvedic* texts, especially *Sushruta Samhita*, describe various surgical instruments with precise measurements and their specific applications. These instruments are categorized based on their function and anatomical considerations as per *Sharir Rachana* (Anatomy).

Sushruta, considered the "Father of Surgery," described 101 blunt instruments (*Yantras*) and 20 sharp instruments (*Shastra*), which were meticulously designed keeping in mind the human body's structure and requirements for precise surgical interventions.

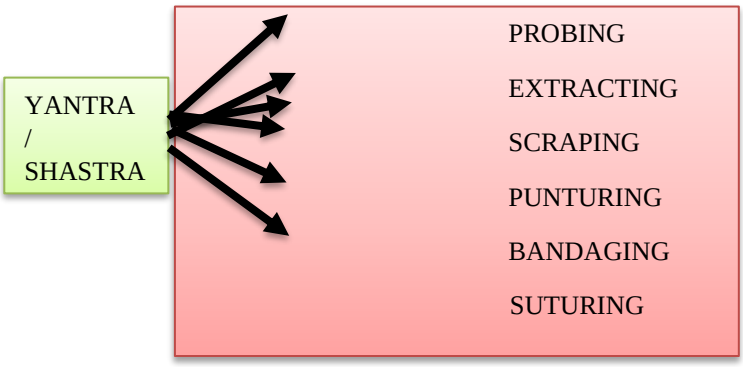
Ergonomics is the scientific study of designing tools, instruments, and work environments to enhance efficiency, safety, and comfort. In *Shalya Tantra* (Surgical Ayurveda), ergonomics plays a crucial role in shaping surgical instruments (*Shalya Yantras*) based on human anatomy (*Sharir Rachana*) and physiological needs.

Sushruta, often regarded as the Father of Surgery, incorporated ergonomic principles in designing *Shalya Yantras* to ensure:

- Precision in handling
- Ease of use for surgeons
- Minimal strain and fatigue
- Maximum efficiency with minimal invasiveness

This branch of Ayurveda utilizes different instruments/equipments or materials for surgical purpose. These *Shastra* mainly crafted from stone, wood, leaves, metals and branches of trees, etc. Also, The *Shastra* made from skin, teeth and horn, etc. of animals and birds also used in *Ayurveda* surgery. The instruments used in *Ayurveda* surgery given name on the basis of their shape, size, appearance, application or origin, etc. Such as *Simhamukha* instruments look like lion forceps while *Shalya* instruments look like *Sharari* bird termed as *Shararimukha*. The some equipment are very common used in Ayurveda as well as modern surgery e.g. dissection forceps, dressing forceps, scissors and spring forceps. [1-3]

Fig 1: Major applications for instruments in Ayurveda surgery



Classification of *Shalya* Instruments

तानि षट्प्रकाराणि; तद्यथा- स्वस्तिकयन्त्राणि, सन्दंशयन्त्राणि, तालयन्त्राणि, नाडीयन्त्राणि, शलाकायन्त्राणि, उपयन्त्राणि चेति || [4]

Sushruta divided the instruments into two major categories:

1. ***Yantras* (Blunt Instruments – 101 types)**

तत्र, मनःशरीराबाधकराणि शल्यानि; तेषामाहरणोपायो यन्त्राणि || [5]

- Used for holding, grasping, pulling, or exploring.
- Includes *Swastika*, *Sandamsha*, *Tala Yantra*, etc.
- Classified in 6 types

1. *Swastika Yantra*- [Cruciform instruments] - 24
2. *Sandamsha Yantra* - [Dissecting forceps]- 2

3. *Tala Yantra* - [Scoops]- 2
4. *Nadi Yantra* - [Tubular instruments]- 20
5. *Shalaka Yantras* - [Probe like instrument] - 28
6. *Upayantra*- [Accessory instruments] - 25

2. ***Shastras* (Sharp Instruments – 20 types)**

- Used for cutting, incising, excising, and puncturing.
- Includes *Mandalagra*, *Karapatra*, *Eshani*, etc.

Additional Classification

1. *Anuloma Yantra* (Instruments acting in the direction of body structures)
2. *Pratiloma Yantra* (Instruments acting against body structures)
3. *Samdamsha Yantra* (Forceps-like instruments)

2. Objectives

- To analyse the anatomical considerations that Acharya has given in the design of surgical instruments.
- To study the reflection of surgical instruments of Acharya Susrutha in modern surgical instruments

3. Methods

This study was conducted as a structured literature review with the objective of exploring the anatomical and ergonomic rationale behind the design and dimensions of Shalya Yantras (surgical instruments) as described in classical Ayurvedic texts, particularly in the *Sushruta Samhita*. The methodology involved the following steps:

1. Source Selection

A comprehensive review of primary classical Ayurvedic texts was undertaken, including:

- *Sushruta Samhita* (*Sutra* and *Chikitsa Sthana*)
- *Ashtanga Hridaya* by *Vagbhata*
- *Charaka Samhita* for supplementary anatomical references

2. Inclusion Criteria

- Descriptions of Shalya Yantras and Shastras
- Dimensions of instruments as per *Anguli Pramana* (finger breadth)
- Textual references highlighting ergonomic design principles
- Modern surgical parallels of ancient instruments
- Anthropometric and anatomical considerations in instrument crafting

3. Data Extraction and Thematic Classification

Information from the selected texts was systematically extracted and categorized under the following themes:

- Classification of Shalya Yantras (blunt and sharp instruments)
- Shape, size, and measurements (Anguli-based)
- Purpose and functional use of each instrument
- Correlation with anatomical structures and surgical ergonomics
- Comparison with modern surgical instruments

A thematic matrix was created to organize dimensions, applications, ergonomic features, and modern equivalents.

4. Ergonomic Analysis Framework

A cross-comparison framework was applied to correlate Ayurvedic ergonomic principles with modern ergonomic and biomechanical standards, covering:

- Anthropometry and hand grip biomechanics
- Weight distribution and balance
- Instrumental design for reducing surgeon fatigue
- Minimizing repetitive strain injuries (RSI)
- Enhancing precision and control

Contemporary ergonomic literature was reviewed from surgical equipment design references to validate the relevance of Ayurvedic instrumentation.

4. Results and Discussion

Dimensions of Shalya Instruments

Sushruta Samhita provides specific dimensions of these instruments based on *Anguli Pramana* (Finger Measurement), which varies according to an individual's body structure.

Table no. 1: General dimensions of some important Instruments

Instrument	Type	Shape & Dimensions	Use
Mandalagra Shastra	Sharp	4 Angula long, Circular knife	Incision and debridement
Karapatra Shastra	Sharp	6 Angula long, axe-like	Cutting thick tissues and bones, scraping
Eshani Shastra	Sharp	3-4 Angula long, probe-like	Probing and foreign body removal
Swastika Yantra	Blunt	10-12 Angula long, cross-shaped	Holding tissues
Sandamsha Yantra	Blunt	8-10 Angula long, forceps-like	Grasping foreign bodies
Tala Yantra	Blunt	8-10 Angula, spoon-like	Exploration and cleaning
Vrihimukha Shastra	Sharp	5-6 Angula, trocar and canula	Incision and drainage
Ardhadhara Shastra	Sharp	4-5 Angula, half-moon blade	Scraping tissues
Suchi Yantra	Sharp	3-4 Angula, needle-like	Suturing and puncturing
Mudrika Yantra	Sharp	8-10 Angula, scoop-like	Designed to cut through a small skin incision with minimal damage to surrounding tissues. *(Kanthgata Roga)*

*** *Angula* ≈ 1.89 cm (Varies based on individual body proportion).**

Scientific Basis of Dimensions in Relation to Anatomy

- The size and shape of instruments were designed according to the *Sharir Rachana* (anatomy) of different body parts.

- The length of a scalpel (*Mandalagra*) corresponds to finger breadths to maintain precision in incisions.
- Forceps (*Sandamsha Yantra*) were designed in accordance with gripping power and bone structure.
- Probes (*Eshani*) were developed based on the depth of body cavities to minimize trauma.

Ergonomic Principles in *Shalya Yantra* Design

The Ayurvedic surgical instruments were crafted considering:

1. **Anthropometry (Body Measurements):**

○ Dimensions of instruments were based on the *Anguli Pramana* (Finger Breadth Measurement), ensuring proper grip and control.

○ Example: *Mandalagra Shastra* (Scalpel) was designed 4 *Angula* long, allowing an optimal balance between length and usability.

2. **Biomechanics of Hand Movements:**

○ Instruments were designed according to hand muscle movements to minimize surgeon fatigue.

○ Example: *Sandamsha Yantra* (Forceps) had a length of 8-10 *Angula*, ensuring a comfortable grip and controlled pressure while grasping tissues or foreign bodies.

3. **Weight Distribution and Balance:**

○ Heavy instruments could lead to hand strain and errors; hence, *Ayurvedic* instruments were made of lightweight metal alloys or sturdy wood.

○ Example: *Eshani Yantra* (Probe) was designed with a thin, lightweight structure to aid in gentle probing without excessive pressure.

4. **Minimizing Repetitive Strain Injuries (RSI):**

○ Instruments like *Karapatra Shastra* (Bone Cutter) had a curved ergonomic handle to distribute force efficiently.

This prevented wrist strain and muscle fatigue, enhancing long-term surgical performance.

Modern Correlation

Table no. 2: The *Ayurvedic Shalya Yantras* can be correlated with modern surgical instruments as follows:

***Ayurvedic* Instrument**	**Modern Equivalent**
Mandalagra Shastra	Surgical Scalpel
Karapatra Shastra	Bone Cutter
Eshani Shastra	Surgical Probe
Sandamsha Yantra	Forceps
Vrihimukha Shastra	Lancet
Suchi Yantra	Surgical Needle

Ardhadhara Shastra	Curette
Mudrika Yantra	Spoon Excavator

Importance of Ergonomics in *Ayurvedic* Surgical Instruments

1. Precision and Accuracy in Surgery

- Proper grip and manoeuvrability ensure clean incisions and controlled dissections.
- Example: *Vrihimukha Shastra* (Lance-like Scalpel) enables precise cutting, reducing excessive tissue damage.

2. Surgeon Comfort and Reduced Fatigue

- Well-designed handles and lightweight materials help reduce muscle fatigue, enabling surgeons to perform complex procedures for extended durations.
- Example: *Swastika Yantra* (Holding instrument) allows better handling with minimal wrist strain.

3. Enhanced Patient Safety

- Properly designed instruments ensure minimized trauma, reduced bleeding, and better healing.
- Example: *Tala Yantra* (Spoon-shaped instrument) ensures safe exploration of wounds without excessive tissue damage.

4. Efficiency in Surgical Procedures

- Optimized length and shape of instruments reduce surgical time, improving efficiency and accuracy.
- Example: *Suchi Yantra* (Surgical Needle) was designed for easy suturing with minimal hand strain.

5. Relevance in Modern Surgical Practices

- The fundamental principles of *Ayurvedic* ergonomics are applied even today in the design of modern surgical tools.
- Example: *Ardhadhara Shastra* (Curette-like instrument) has a modern equivalent in periodontal curettes used in dental surgeries**.**

Recent advancement [6-7]

- Recently, innovative training modules have been developed to integrate new surgical procedures.
- A less invasive approach has been devised.
- Currently utilized disposable sutures that do not necessitate post-surgical treatment.
- Sterilization methods for preserving hygienic conditions, include ultraviolet sterilization and steam sterilization of equipment.
- Prevention of contamination by the utilization of aseptic conditions, employing filters and sterilization techniques.
- Alteration in *Shalyagar* for the convenience of patients and physicians.
- Alteration of diagnostic tools and application of *Nadiyantra*.
- Progress in *Agnikarma* and *Jalaukavcharan* methods, among others.
- A novel drug delivery technology enhances drug bioavailability, hence providing expedited benefits in emergency surgical care.
- Utilization of cosmetic surgery within Ayurvedic practice.

- Progress in NASA-Sandhana with contemporary rhinoplasty techniques.
- Progress in reconstructive surgery, such as *Karna Sandhana*, which pertains to ear reconstruction procedures.
- Ayurveda delineated a method for ear reconstruction utilizing a flap from the cheek.
- *Oshtha Sandhana* is a contemporary *Ayurvedic* surgical procedure for lip reconstruction.
- Surgical procedures such as *Langalaka Ardhalangalaka* are employed to excise the fistulous tract.
- Perineal lithotomy employed for stone extraction.
- *Ayurveda* has recently employed radiation for sterilizing purposes.
- Fumes from *Neem, Asafoetida, Shalmali,* and *Marich* are utilized to disinfect sick rooms.

Contemporary surgical practices recommend that surgeons trim their nails and hair to prevent contamination and harm during surgical procedures.

5. Discussion

Acharya Sushruta's description of *Shalya Yantras* was based on scientific anatomical considerations, ensuring precision, safety, and effectiveness in surgery. The detailed dimensions and classifications provide a strong foundation for modern surgical practices. Understanding these *Ayurvedic* instruments helps bridge the gap between ancient and modern surgical sciences, proving *Ayurveda's* relevance in contemporary medicine.

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