

Integration of Ayurvedic Surgical Wisdom with Modern Technology: Development of a Ultramodern Mechanized Ksharasutra Thread Preparation Instrument.

Dr. Hemant Toshikhane,¹ Dr. Harish Daga², Dr. Kamal Patel*³

*^{1,2,3}Department of Shalya Tantra, Parul Institute of Ayurved, Parul University, Limda, Waghodiya, Vadodara, Gujarat, INDIA.

*Corresponding Author: Dr. Kamal Patel,

PG Scholar, Department of Shalya Tantra, Parul Institute of Ayurved, Parul University, Vadodara – 391760.

Email ID: kamalpatel11101998@gmail.com

Abstract:

Background: Ksharasutra therapy is a well-established and widely practiced para-surgical procedure in Ayurveda for the management of anorectal disorders such as fistula-in-ano, sinus, and haemorrhoids. Rooted in the principles described by Acharya Sushruta, this technique employs a medicated thread coated with alkaline and herbal substances to achieve controlled chemical cauterization, excision, and healing. Despite its proven clinical efficacy, the traditional method of Ksharasutra preparation remains largely manual, labor-intensive, time-consuming, and highly dependent on individual skill, environmental conditions, and seasonal availability of raw materials. These factors often result in variability in coating uniformity, pH, tensile strength, and sterility, thereby affecting standardization and reproducibility. With the increasing clinical demand for Ksharasutra therapy and the need to align Ayurvedic pharmaceutical practices with contemporary quality-control standards, there is a growing necessity to modernize its preparation process. Mechanization and automation offer a promising solution to overcome limitations of conventional methods by ensuring uniformity, minimizing contamination, and improving efficiency. In this context, the present study was undertaken to integrate classical Ayurvedic surgical wisdom with modern technology through the development of an ultramodern mechanized instrument for standardized Ksharasutra thread preparation.

Objective: To design and develop an ultramodern mechanized instrument for the standardized, efficient, and reproducible preparation of Ksharasutra threads by integrating classical Ayurvedic principles with modern technology.

Materials and Methods:

Designing & Development of Ultramodern Mechanized Instrument For Ksharasutra Preparation

Study centre- Parul Institute of Ayurved, Parul University

Material- Aluminium extrusion for machine base, Embedded control unit, Heater, tensioners, Motor with pulleys, UV lights etc.

Methods- Construction of Aluminium extrusion frame & Mounting assemblies of Thread coating, Temperature control, Motor speed control, Thread tension control, LED UV. Sterilization.

Key Words: Ksharasutra, Mechanized Ksharasutra preparation, Fistula-in-ano, Para-surgical procedure, Standardization, Ultramodern medical device, Apamarga Kshara, Shodhit Guggulu, Haridra, UV sterilization,

How to cite this article: Toshikhane H, Daga H, Patel K. Integration of Ayurvedic Surgical Wisdom with Modern Technology: Development of an Ultramodern Mechanized Ksharasutra Thread Preparation Instrument. Int J Drug Deliv Technol. 2026;16(30s):953-959. DOI: 10.25258/ijddt.16.30s.97

1. INTRODUCTION:

In terms of Ayurvedic surgery, the time of Acharya Sushruta was undoubtedly the golden age.^[1] An overview of the history of Ayurvedic medicine in general and surgery in particular shows that a number of surgical techniques were carried out back then that seem like miracles

now.^[2] Due to a number of prevalent conditions, the surgical practice gradually declined over time.^[3] One such area that still has a lot of room for Ayurvedic research is the discipline of prostology.^[4] Ayurveda undoubtedly has enormous potential to address the difficult and unresolved issue of numerous ano-rectal

illnesses.^[5] For generations, fistula-in-ano and sinus disorders have been successfully treated using ksharasutra, a parasurgical technique utilising a medicinal thread.^[6] Snuhiksheera (Nerifolia latex), Apamargakshara (Acyranthesaspera ash), and Haridra (Euphorbia (Curcuma longa powder)) are used in the traditional production of Ksharasutra.^[7] But the traditional way of gathering Snuhiksheera is labour-intensive, time-consuming, and dependent on seasonal availability.^[8] This restriction emphasises the need for a more effective and dependable way to prepare Ksharasutra, guaranteeing constant quality and year-round accessibility.^[9] This paves the way for the

*Author for Correspondence: : kamalpatel11101998@gmail.com

introduction of a new, standardised, and effective technique or tool for making Ksharasutra threads, which can solve these issues and enhance the therapeutic procedure.^[10] An instrument made by Ksharasutra that guarantees consistent thread quality while streamlining the process and cutting down on preparation time. This tool helps modernise Ayurvedic medicine, increasing the effectiveness and accessibility of Ksharasutra treatment for patients all around the world.^[11]

2. HISTORICAL CONTEXT OF KSHARASUTRA:

When tied, the thread that has been frequently saturated or coated with Rajanichurna (turmeric powder) and Snuhiksheer (Euphorbia Nerifolia latex) will cut and eradicate Arsha (Piles) and Bhagandara (Ano fistula) from their root.^[12]

Ayurvedic surgery pioneer Ksharasutra was first referenced by Acharya Sushruta (6th century BCE) in relation to the treatment of Bhagandara (fistula) and Nadvirana (sinus).^[13]

• VENTURIMETER^[14]:

One kind of flowmeter that operates on the principle of principle is the venturimeter. The water, chemical, pharmaceutical, and oil and gas industries all make extensive use of this instrument to gauge the fluid flow rates within pipes.

A manometer is used to measure the pressure differential created by reducing the cross-sectional area of the pipe in order to calculate the fluid flow rate. Thus, the venturi meter is a differential head type flowmeter that transforms pressure energy into kinetic energy in-ano), Arbuda (benign tumour), etc., but there was no emphasis on how to prepare it. The preparation technique and its indication in Bhagandara (fistula-in-ano) and Arsha (haemorrhoids) were first mentioned by Chakrapani Dutta in the eleventh century.

A superior Kshara Sutra preparation was introduced in Rasatarangini (200 years ago), which was then published to Chakradutta. In the modern age, Prof. P.J. (1951-78) et al. are largely responsible for standardisation and development for practical application. Additionally, CCRAS and ICMR have expanded their work with studies that have been verified by science. Its preparation used to necessitate time-consuming manual procedures, which resulted in variability and restricted scalability. In order to modernise production, the idea of Ksharasutra preparation machines was developed.

3. AIM:

To Design & Develop Ultramodern Mechanized Instrument for Ksharasutra Preparation.

4. OBJECTIVES:

Preparation of Apamarg-Guggulu-Haridra Ksharasutra Threads from The Instrument.

5. NEED OF STUDY:

- Previous studies have focused on different forms of Ksharasutra, their comparative analysis, and alternative forms of therapy.
- This study emphasizes on Ksharasutra Preparation by Ultramodern Mechanized Instrument.
- This instrument aims to prepare Ksharasutra thread with uniformity in coating, pH, tensile strength and other parameter of standardization.
- It also saves time, minimizes human efforts, human errors and contamination of any foreign material. The traditional preparation of Ksharasutra threads is plagued by inconsistencies, variability, and labour-intensive processes, which can lead to:

- A. Inconsistent treatment outcomes
 - B. Limited availability of high-quality threads
 - C. Seasonal fluctuations in raw material supply
 - D. Time-consuming and labour-intensive preparation
 - E. Potential contamination and quality control issues
- To address these challenges, there is a pressing need for a standardized, efficient, and reliable method of preparing Ksharasutra threads.

This study aims to develop a Ksharasutra preparation device that:

- A. Ensures consistent thread quality
- B. Simplifies and streamlines the preparation process
- C. Enhances treatment outcomes
- D. Increases accessibility and availability of Ksharasutra treatment
- E. Integrates traditional Ayurvedic wisdom with modern technology

By developing such a device, this study seeks to modernize the preparation of Ksharasutra threads, ultimately improving patient care and advancing the field of Ayurvedic medicine.

6. METHODOLOGY:

INSTRUMENT DEVELOPMENT:

System Design and Prototype Development in Department of Shalyatantra, Parul Institute of Ayurved.

SYSTEM DESIGN AND PROTOTYPE DEVELOPMENT:

The system prototype design includes drawing, mechanical work, electronics & Microcontroller programming.

• STUDY CENTRE:

Parul Institute of Ayurved, Parul University, Post Limda, Vadodara, Gujarat-391760

• STUDY DESIGN - EXPERIMENTAL STUDY SOURCE OF DATA

• LITERARY SOURCE:

The literature Ksharasutra Preparation classical text of Ayurveda and of modern science updated with various journals and internet.

• PHARMACEUTICAL SOURCE:

Raw Drugs were procured from authorised drug vendor.

• **QUALITY CONTROL STUDIES:**

The Parul Institute of Ayurveda's Quality Control (QC) Lab is where the Physico-Chemical and Phytochemical Evaluation of Ksharasutra prepared using Ultramodern Mechanised Instrument is carried out. The parameters are evaluated using the methodology described in the Ayurvedic Pharmacopoeia of India (API). These will be contrasted with the corresponding values of the ICMR-recommended Standard Ksharasutra.

• **SYSTEM DESIGNING & PROTOTYPE DEVELOPMENT:**

Prototype development involves creating a preliminary model of a product or device to test its functionality, design, and performance.

It required:

- A. Conceptualization: Refined the idea and defined the project requirements.
 - B. Design: Created detailed designs and specifications.
 - C. Material Selection: Chose suitable materials for the prototype.
 - D. Building: In-house Construction of the prototype was done.
 - E. Testing: Evaluation of the prototype's performance, identification of issues, and gathering of feedback was done.
 - F. Refining: Made necessary modifications and improvements.
 - G. Iteration: Repeated the process until the desired outcome was achieved.
 - H. Finalization: Prepared the prototype for production & further development.
- Thus, Prototype development helped to identify potential problems, reduces risks, and ensures a more efficient production process.

• **DESIGNING OF PROTOTYPE:**

Based on the specified needs, comprehensive design specifications were developed. This covers the choice of materials, measurements, and essential functional elements including the UV sterilisation unit, drying chamber, and coating assembly. A 3D model of the instrument was created using computer-aided design software (FUSION 360), which allowed for visualisation and iterative design improvement. The 3-D design images are as below.

• **COMPONENTS AND PARTS OF INSTRUMENT:**

SPOOL HOLDER & BARBOUR THREAD SPOOL:

Use- To facilitate winding and unwinding of Barbour linen Thread.

THREAD GUIDE

THREAD TENSIONER-1:

Use- Thread tangling and breakage are decreased by the thread tensioner. It enhances the consistency and quality of the product. It aids in raising productivity and efficiency. It improves accuracy and precision.

COATING ASSEMBLY:

Use- To Provide a uniform coating of Ksharasutra coating paste on Barbour linen thread moving at a speed of 1.14cm/sec.

THREAD TENSIONER-2:

The Thread tensioner no. 2 controls and adjusts the tension of the thread, ensuring its consistent and optimal supply to Pulley with Motor.

PULLEY with MOTOR:

Use- Power supply: 12V DC
Motor speed: 10 revolutions per minute (RPM)
Linear speed: 1.14 centimetres per second (cm/sec)

HEATING ASSEMBLY:

Use- It Maintains a consistent temperature between 40°C to 60°C (104°F to 140°F) for drying of prepared Ksharasutra. It reduces moisture content to a level suitable for storage and use.

ELECTRONIC CONTROL UNIT WITH SWITCHES & LCD DISPLAY AND

LEDS:

Use- It provides below listed features for operation of the instrument.

SWITCHES:

The description of switches are described below

- 1. **Power:** Toggle switch for Power On/Off
- 2. **Motor:** Push buttons switch to activate or deactivate the motor.
- 3. **UV Light:** A push button switches to activate or deactivate the Ultraviolet LED Lamps
- 4. Two other buttons for future development

LCD Display:

The below characters are displayed on the screen of LCD display

- 1. Name of Instrument
- 2. Name of Guide
- 3. Name of Co-guide
- 4. Name of Scholar
- 5. Design Patent no

LED Display:

- 1. Red- UV lights on/off
- 2. Red- Motor on/ off

Figure (I) show Electronic Control Unit With Switches & LCD Display And LEDs

MICROCONTROLLER CIRCUIT:

Use- Microcontroller Atmega32 (8-bit Microcontroller)

PCB: Double Layer Copper Glass Epoxy PCB
LCD: 16 X 2 Alphanumeric Display, White pixel with Blue Backlight

UV LIGHTS:

Use- Disinfection and sterilization of instrument as well as the final product.

ALUMINIUM MOUNTING BRACKET:

Uses- The machine's aluminium extrusion channel base frame allows for flexible component installation for prototype construction.

POWER SUPPLY SMPS (220V-24V):

Use- An Indian firm called Rishabh produces Switch Mode Power Supplies (SMPS). Switching electronics are used by SMPS power supplies to control the output voltage.

Input: Voltage: 230V AC Frequency: 50Hz Output: 24V

POWER SUPPLY:

Mains Voltage: 230 VAC, Mains Frequency: 50 Hz, Maximum Power Consumption from: 300 Watt

Figure (II) show Ksharasutra Instrument

7. PATENT:

Published IPR of Design Registration in Journal no.34/2024

CERTIFICATE OF REGISTRATION OF DESIGN:

Figure (III) show Patent Certificate

• PREPARATION of KSHARASUTRA COATING PASTE:

Ksharasutra Coating Paste was prepared at the Parul Institute of Ayurved, Vadodara's Department of Rasashastra & Bhashajyakalpana, a GMP-certified pharmacy. In terms of pH and consistency, our methodical analysis of several permutation possibilities produced a positive result.

8. SOP FOR KSHARASUTRA PREPARATION:

This SOP describes how to use the automated system to prepare Ksharasutra threads step-by-step. It guarantees the manufacturing of sterile, uniform, and clinically compliant Ksharasutra threads.

• MATERIALS AND EQUIPMENT:

Barbour Linen Thread No. 20
Coating materials: Shodhit Guggulu, ApamargaKshara, Haridra churna
Mechanized Ksharasutra preparation device
UV sterilization lamps
Precision balance
Sterilized glass tubes with rubber caps
Desiccant bags (silica gel)
Personal protective equipment (PPE): gloves, lab coat, safety glasses

• THREAD LOADING AND SETUP:

Load Thread Spool:

Put the Barbour Linen Thread No. 20 spool into the instrument's spool holder. After passing through the thread guide, tensioner 1, coating assembly, and tensioner 2, thread the string onto the pulley using the DC motor.

Thread Alignment:

To enable smooth movement through the instrument, make sure the thread is properly aligned, tensioned, and free of knots or slack.

Calibration:

Adjust the device's parameters according to the necessary thread tension and coating thickness. Before beginning the process, make sure all the settings are correct.

• COATING PROCESS:

A. Pre-heat Drying Chamber:

Pre-heat the drying chamber to 50°C for 10 minutes.

B. Activate Coating Process:

Fill the coating assembly container with the prepared coating paste. Press the "M" switch on the control panel to turn on the motor. The paste will be evenly applied to the thread as it passes through the coating assembly.

C. Monitor Coating:

Watch the thread as it moves through the coating assembly. Make sure the coating is applied uniformly along the thread's whole length.

D. Drying:

The coated thread will get drying temperature of 50°C for 30 minutes to ensure proper drying of the coating material.

E. Sterilization:

While the thread is drying, turn on the UV sterilization lamps to begin the sterilization process. Ensure that the entire thread is exposed to UV light.

• CUTTING AND PACKAGING:

A. Cutting Threads:

After drying and sterilization, the Ksharasutra threads were cut into standard lengths of 25 cm using sterile scissors.

B. Packaging:

The cut threads were kept into sterilized glass tubes sealed with rubber caps. The silica desiccant bags were kept in final packing to absorb moisture.

Labelling of the final pack with the batch number, date of manufacture and other relevant information was done.

C. Storage & Preservation:

Store the packed threads in a cool, dry place, protected from light and Moisture.

Ksharasutra preserved up to 7th days from the date of manufacture has been considered as fresh Ksharasutra.

Ksharasutra preserved for 60 to 67 days from the date of manufacture has been considered as preserved Ksharasutra.

Image (IV) – Ksharasutra Thread Prepared from Instrument

MAINTANANCE:

After every use, clean the chemical assembly and remove any remaining coating material.

To keep the equipment operating at its best, conduct routine maintenance checks.

Any worn or broken parts should be replaced right away.

TROUBLESHOOTING:

Check the thread alignment and coating paste consistency if the coating looks uneven.

Reduce the tension settings and check the thread for flaws if it breaks throughout the procedure. Check all electrical connections and make sure the control panel is operating properly if the device doesn't work.

SAFETY PRECAUTIONS:

Put on the proper personal protective equipment (PPE), such as lab coats, goggles, and gloves. To avoid electrical dangers, make sure the machine is correctly grounded.

Before operating, read and comprehend the SOP for thread preparation.

If the machine is broken or not working properly, do not use it.

EQUIPMENT AND MATERIALS:

Raw materials for Ksharasutra preparation (Ksharasutra coating paste, Barbour linen thread no 20 spool, sterile glass tube with cap, packaging material, desiccant silica bags, sterile scissors, container for pouring), Cleaning supplies (e.g., disinfectant, cloths), PPE, lab coats, goggles.

9. DISCUSSION:

Ksharasutra therapy is an established Ayurvedic para-surgical technique; however, its traditional preparation is labor-intensive, time-consuming, and prone to variability and contamination. The ultramodern mechanized Ksharasutra preparation instrument developed in this study effectively addresses these limitations by integrating classical Ayurvedic principles with modern engineering technology. The device ensures uniform coating, controlled drying temperature, optimal thread tension, and UV sterilization, thereby improving consistency, safety, and reproducibility of Ksharasutra threads. Mechanization significantly

reduces human error and dependence on environmental conditions, enhancing standardization as per Ayurvedic Pharmacopoeia guidelines. This innovation supports efficient large-scale production while maintaining the therapeutic integrity of traditional formulations.

10. CONCLUSION:

The ultramodern mechanized Ksharasutra preparation instrument provides a standardized, efficient, and reliable method for producing high-quality Ksharasutra threads. By minimizing manual variability and contamination, the device improves quality control and clinical applicability. This development represents an important step toward modernizing Ayurvedic surgical practices and promoting wider acceptance of Ksharasutra therapy in contemporary healthcare settings.

11. References:

1. Sushruta Samhita; Dalhana, Nibandhasangraha commentary; Edited by Jadavji Trikamji Acharya and Narayan Ram Acharya; Chowkhamba Surabharati Prakashan, Varanasi.
2. Sadananda Sharma, Rasa Tarangini, Hindi commentary by kashinath Shastri, Motilal Banarasidas, Delhi.
3. Chakrapani, Chakradatta, Hindi commentary by Ravidutta Shastri, Chaukhamba Surabharati prakashana, Varanasi.
4. Bhava Mishra, Bhava prakasha, Vidyotini Teeka by Shree Harihara Prasad Pandey, Chaukhamba Sanskrita Bhavan, Madhyam khanda.
5. The Ayurved Pharmacopoeia of India Part-II (Formulations) Volume-I. First edition. Govt. of India,Publication, New Delhi. Appendix: 9.
6. The Ayurved Pharmacopoeia of India Part-II (Formulations) Volume-II. First edition. Govt. of India,Publication, New Delhi. Appendix: 7-8.
7. Ksharasutra- The Ayurvedic Scalpel Of Proctologist For Fistula In Ano- Dr Hemant Toshikhane, Dr Narendra thakor, Dr Harish Daga.
8. "Ksharasutra: An Ancient Ayurvedic Technique" by Dr. R. K. Mishra (Shroff Publishers, 2012).
9. Colorectal Diseases & Ksharasutra Surgery, 2nd edition,Dr Lalta Prasad, Chaukhamba publications.
10. Bailey & Love's Short Practice of Surgery,28 th edition,Author: Norman S Williams; Edition: 28th; Publisher: CRC Press; Year: 2023.
11. Ayurvedic Perception On Kshara Kalpana In Haemorrhoids. 299.
12. Dr Harish Daga. Ebooks.Ksharasutra- Ayurvedic Scalpel Of Proctologist For Fistula In Ano.
13. Instant Ksharasutra Machine Developed By Dr Mahesh N Chaudhary Et Al At Chaitanya Ayurved College, Maharashtra (2024).
14. "Pharmacological and Therapeutic Effects of Ksharasutra" (Indian Journal of Pharmaceutical Sciences, 2018).

Figure (I) - Electronic Control Unit With Switches & LCD Display And LEDs:



Figure (II) - Ksharasutra Instrument:

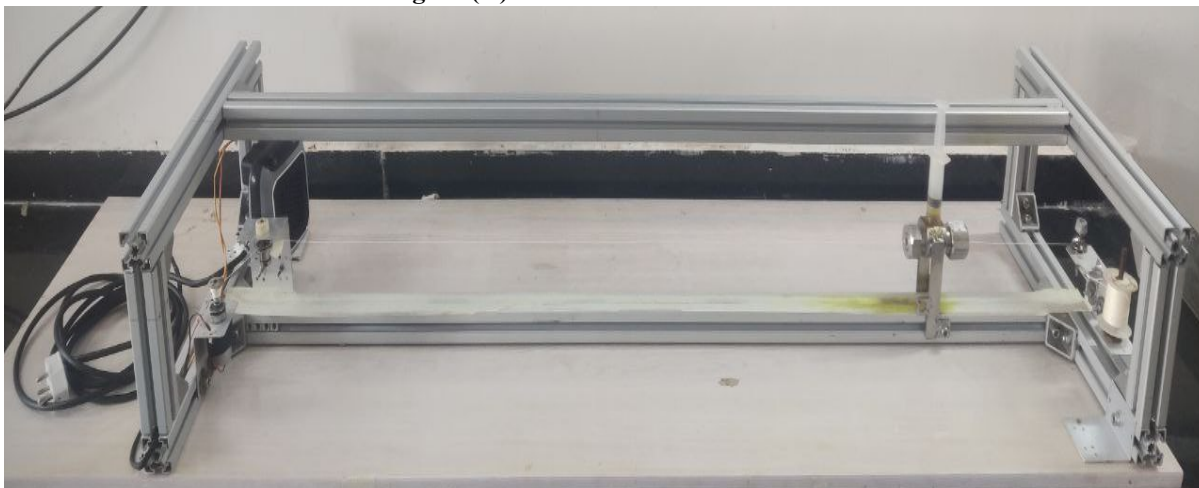


Image (III) - Patent Certificate:



Image (IV) – Ksharasutra Thread Prepared from Instrument

