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YANTRA: PRESERVING ANCIENT SURGICAL INNOVATIONS

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ABSTRACT

The article explores the profound impact of *Yantra*, a collection of precision surgical instruments rooted in ancient Indian medical practices. Examining texts like *Susruta Samhita* and *Astanga Hrudaya*, the study delves into the meticulous categorization and functionalities of various *Yantra* types. From *Swastika Yantra*, resembling modern Artery forceps, to *Nadi Yantra* resembling hollow tubular instruments like proctoscope, each instrument served specific surgical needs. Highlighting the ancient significance, the article emphasizes how *Yantra's* detailed documentation laid the groundwork for subsequent surgical innovations. It delves into the enduring influence of these ancient instruments on modern surgical tools, showcasing the evolution from ancient craftsmanship to contemporary surgical precision. Today's instruments, while drawing inspiration from *Yantra*, exhibit enhanced materials and ergonomic designs, elevating surgical accuracy and minimizing tissue damage. The article concludes by underlining the enduring legacy of *Yantra*, emphasizing its pivotal role in shaping the practice of surgery across millennia. It serves as a testament to the visionary craftsmanship of ancient Indian surgeons, transcending time to enrich and influence modern surgical practices.

KEYWORDS: *Yantra*, *Susruta Samhita*, Surgical instruments.

INTRODUCTION

Susruta, an eminent sage, philosopher, and pioneering surgeon of ancient India, left an indelible mark on the history of medicine around 600 BC. His monumental contributions, particularly in the realm of Surgery, transcend time and space. Renowned globally, he holds a distinguished place for his groundbreaking advancements in surgery, notably in the domain of Plastic Surgery, with a focus on procedures like Rhinoplasty.

The rich surgical heritage of ancient India, meticulously documented in texts such as *Susruta Samhita, Astanga Sangraha*, and *Astanga Hrudaya,* illuminates a profound treasure trove of knowledge. Central to this legacy are the intricate details of *Yantra* – an extensive array of precision surgical instruments that revolutionized medical practices in antiquity.

Susruta's visionary conception of surgical instruments, encompassing detailed descriptions of their quality, methods of manufacture, and nuanced usage, stands unparalleled. He stands as the pioneer, being the first surgeon globally to comprehensively describe various surgical instruments catering to different facets of *Shalya Harna Karma*[1], an accomplishment far beyond the reach of contemporaries. His far-reaching foresight and pioneering contributions position him as an unparalleled luminary, significantly ahead of his time in the domain of surgical instrumentation and practices.

Historical Context and Significance of *Yantra*

Hippocratic Corpus (430 to 330 B.C)[2]

The treatise, On Surgery outlines the process to which the surgeon should conduct surgeries On Dislocations and On Fractures, setting bones and fractures and removing bone fragments were important to the field of orthopaedics, being very similar to modern techniques. Bloodletting is also an important surgical technique mentioned in the Regime.

Hellenistic Alexandria (323-31 B.C.)[2]

Herophilus (c. 325-255 B.C.) and Erasistratus (c. 304-250) were pioneers in the field of anatomy and dissection. The methodology of measuring heart rates and the pulse were used with water clocks. Apollonius of Citium (fl. c. 60 B.C.) simplified methods in repairing joints and other physical injuries for his illustrated treatise, On Joints, helping both surgeons and nonphysicians understand physical injuries.

Medicine in Rome (c. 129-200 A.D.)[2]

The emergence of medical writers like Galen brought new advancements into the medical field. The majority of previous writings were lost. Other medical writers mention speculums used for the vaginal and rectal areas which are similar to the tools used today. Bone levers are also mentioned and were typically for teeth or minor bone damages. Probes were important guides during surgery and treating wounds. In general, most tools were made from a form of metal or wood and did not evolve too differently from Greece to Rome.

Back in the 6th century, laboring caused a high mortality rate for both mothers and newborns due to this problem led to the establishment of forceps-assisted delivery in the 16th century by the Chamberlen family.[3]

In 1867, Eugene Koeberle, who accidentally found arterial forceps with a catch closure came away spontaneously without the need for ligature, and invented "pince hémostatique," which have pin and hole catches.[4]

In 1882, the Kocher clamp was created by Emil Theodor Kocher, who significantly contributed to thyroidectomies (removal of all or a part of the thyroid gland) and decompressive craniotomy. This invention decreases the risk of contamination while cutting dense tissue.[4]

Various Types of *Yantra* and Their Intricacies

***SWASTIKA YANTRA*[5]**

The *Swastika Yantra*, an ensemble of surgical instruments, manifests in various forms resembling the faces of fierce creatures such as lions, tigers, and eagles, each bearing names corresponding to their likeness. With lengths measuring 18 *Angula* and featuring ends shaped akin to these formidable beasts and birds, these instruments showcase *Kila* (fulcrums) at the midpoint, approximately the size of a *masura*. Specifically designed for extracting foreign bodies embedded in bones, these instruments, including the Lion Forceps, Tiger Forceps, and Eagle Forceps (Fig.1) exemplify the precision and versatility of the Swastika Yantra, revolutionizing ancient surgical practices.

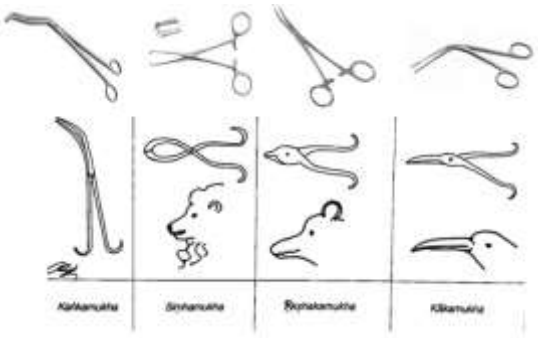

Fig. 1: Comparing the ancient and modern surgical instruments.

SANDAMSA YANTRA[5]

The *Samdamsa Yantra*, reminiscent of modern dissecting forceps, showcased exquisite craftsmanship in ancient surgery. Instruments like *Sanigraha*, *Anigraha*, and *Mucuti Yantra* were precision-crafted for extracting foreign bodies from soft tissues and intricate tasks like removing tiny objects or trimming muscular outgrowths in deep wounds. These ancient *Yantra* find striking correlations in contemporary surgical tools. The *Sanigraha Samdamsa Yantra*, resembling toothed forceps, grasps skin and robust structures, akin to modern surgical forceps. Likewise, the *Anigraha Samdamsa Yantra*, a plain non-toothed forceps, delicately handles vessels and nerves, paralleling modern instruments in surgical precision.

TALA YANTRA[5]

The *Tala Yantra*, resembling fish palate, served diverse roles in ancient surgical procedures, dissection, and foreign body extraction from delicate areas like the ear, nose, and sinuses. Comparatively, contemporary tools like the Gall-stone Scoop mirror its functionality. This modern instrument, adaptable in size for specific anatomical needs, navigates narrow passages within the bile duct, effectively removing debris and manipulating stones. In tandem, modern ear and Volkmann's scoops handle ear wax removal and manage ulcer beds respectively. These parallels underscore the enduring relevance of ancient *Yantra*, bridging past surgical wisdom with modern-day surgical instrumentation.

NADI YANTRA[5]

The *Nadi Yantra*, an assortment of hollow tubular instruments, stands as a testament to the precision and foresight of ancient surgical craftsmanship. These instruments, open at one or both ends, served diverse functions, from extracting obstructed foreign bodies to diagnosing diseases within different body canals. Each instrument was meticulously designed, with specifications varying according to the body's srotas. Descriptions in ancient texts such as

Astanga Sangraha and *Astanga Hrudaya* detail specific dimensions and functions of various *Nadi Yantra*, indicating their diagnostic and therapeutic uses. For instance, instruments like *Nirudhaprakasha* and *Sannirudha Guda Yantra* correlate to modern dilators and catheters, while *Alabu Yantra*, with its specific dimensions, finds a modern counterpart in cupping glasses for *rakta mokshana* or bloodletting. Similarly, the *Sringa Yantra*, with its horn-like structure, mirrors tools used in *rakta mokshana*, emphasizing the enduring relevance and sophisticated design of these ancient instruments in contemporary medical practices.

***SHALAKA YANTRA*[6]**

The *Shalaka Yantra*, a diverse array of instruments, serves a multitude of purposes in ancient surgical practices. These instruments vary in size and dimensions, tailored to specific surgical needs. Instruments like *Gandupada Mukha* (Probe), *Sarpaphana* (Retractors), *Sarapunkha* (Elevators), *Badisha Mukha* (Hook), and *Masuradalamatra Mukha* (Ear scoops) have unique functions, including the extraction of *srotogata shalya* and wound wiping with cotton-tied heads (Swab). Their applications are extensive, with instruments like the *Darvi-shaped Shalaka* used for pouring *kshara* and *taila aushadis*, while the *Jambava Mukha* and *Ankushakaar Shalaka* find purpose in *agnikarma*. The diversity continues with specialized instruments like the *Nasaarbuda Harnaartha Shalaka*, designed with a *kolaasthi-shaped osthta* for sharpness, and the *Anjana Salaka*, resembling thick *puspakalika* on both sides, indicating specific uses. Even the shape of the Shalaka is purpose-driven, with round *malti-pushpa*-shaped instruments for *Mutramarga shodana*, showcasing the intricate design and application of these ancient surgical tools.

Modern Modifications and Influence of *Yantra*

The fundamental principles of *Yantra* served as the cornerstone for the development of contemporary surgical tools. Advancements in technology and materials have led to significant modifications, resulting in modern instruments that exceed the capabilities of their ancient counterparts.

Today, surgical instruments crafted from high-quality stainless steel offer enhanced durability and precision. Modern forceps, scissors, and retractors, while resembling their ancient predecessors in functionality, exhibit ergonomic designs and superior materials, minimizing tissue damage and enhancing surgical accuracy.[7]

Technological advancements[8]

- Recent years have witnessed remarkable technological advancements like Robotic-assisted surgery which offer surgeons enhanced precision and accuracy.
- By creating detailed 3D maps of the patient's anatomy, these systems assist surgeons in optimizing implant placement and alignment, leading to improved outcomes and potentially longer-lasting implants.
- 3D printing technology has revolutionized the creation of customized implants and surgical instruments. Surgeons can now tailor implants to each patient's unique anatomy, resulting in better fit and alignment. This personalization contributes to reduced postoperative complications and improved overall function. Minimally invasive techniques Advances in surgical instruments and techniques have enabled surgeons to perform complex surgeries through smaller incisions.

DISCUSSION

The profound influence of ancient *Yantra* on contemporary surgery pays homage to the forward-thinking mindset of ancient surgeons. These instruments, meticulously detailed in classical texts[9], have significantly shaped the design of modern surgical tools. The criteria for high-quality instruments, as outlined in ancient texts, remarkably align with current standards, underscoring their enduring significance. Concepts such as aseptic precautions[10], crucial for preventing infections, were championed in ancient texts and remain fundamental in today's surgical practices. Unlike modern instruments named after inventors or function, *Yantras* derived their names from animals or birds based on their shapes.[11] *Sushruta's* teachings emphasized the paramount importance of the hand in surgery, a sentiment that resonates today, as even with technological advancements like robotic arms, the hand's tactile sensitivity remains unparalleled. *Sushruta*, a renowned expert in *Shalya Tantra*, showcased not only surgical expertise but also engineering skills in crafting instruments for patient care, showcasing his multidimensional knowledge. His teachings continue to guide modern surgery, seamlessly blending ancient wisdom with contemporary medical innovations.

Yantras play an indispensable role in surgeries and wound cleaning, with their uses explained by the *Acharyas*, leaving room for adaptation based on the *Vaidya's* discretion.

Swastika yantras which are modified in today’s world like artery, allis, babcock forceps, Cheatel’s forceps etc are based on the same principle, with a *kila* in the shape of a masura

(lentil) or masuradala (cotyledon of a lentil), the root of the instrument is bent like an *ankusa* as explained in the *Sushruta Samhita*. Hartman ear forceps can be compared to *kankamukha* which is said to be best instrument to extract the deep-seated foreign body.[5]

Tissue forceps, Adson forceps, Bonney forceps, DeBakey forceps, Russian forceps etc, are the modified *Samdamsa Yantra*[5] and *Mucuti Yantra.*[12]

Scoops like Ear Scoop, Volkmann's scoop etc are based on the *Talayantra* explained by the *Sushrutacharya.*[5]

Laproscopic instruments, Bronchoscope, Cystoscope, Endoscope, Proctoscope, RT tube, suction tube etc, are evolved on the principles of *Nadi Yantra* used for different purposes based on the condition.

Instruments like Probe, different type of Elevators, different types of Retractors etc, can be compared to *Shalaka yantra* which serves the same purpose as mentioned in our classical text.[6]

All *Upayantras* are not used todays some of the evolved and modified ones like *rajju* as tourniquet, *vennika* as suture material, *patta* as Bandages, *charma* as skin grafts etc are used as an accessory instrument used in the absence of the other main instruments.

CONCLUSION

The *Yantra* tools from ancient times still guide today's surgeries, showing how smart those old ideas were. *Sushruta* was the first to write down all these different surgical tools, letting doctors make new ones as they need. Knowing about these tools is really important for every surgeon to do their job right. Surprisingly, many of *Susruta's* tools are pretty similar to what doctors use now. That's why they call *Susruta* the "Father of Surgery." His ancient ideas still help doctors today, mixing the old ways with the new to make surgery even better.

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