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Review Article

AYURVEDIC SURGICAL INSTRUMENTS: AN OVERVIEW OF SUSHRUTA'S INNOVATIONS

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ABSTRACT

The history of the surgical instruments' evolution is a remarkable gradual journey from ancient styles to modern technology-based and engineered precision tools. It would not be wrong if the credit for the first revolutionary change in surgical instruments is primarily attributed to an innovative and pioneering ancient abdominal and cataract surgeon named Sushruta, also known as 'the father of Indian surgery.' He is credited with innovations in surgical tools in his classic compendium. The tools, designed and described by this master surgeon, mentor, and clinician, are, no matter the birthplace of their provenance, unused due to their innovative functional designs and critical thought processes. Remarkable contributions include the first needle holder, scissors, haemostatic forceps, cesarean section, bone setting, and many kinds of other general and specific surgical instruments. This review is an endeavour to catalogue all the surgical instruments along with their descriptions-and to discuss them in the prevailing modern scientific scenario.

INTRODUCTION

Surgery occupied an important place in the medical tradition of ancient India. Wounds and bodily injuries were common at a time when hunter-gatherers faced the challenges of subsistence living in a wild environment teeming with life-threatening elements, and the warriors individuals of high social esteem were often involved in battles or one-to- one combat. The history of Ayurvedic surgery dates back to several centuries before the common era. The oldest surgical text in the world is thought to be the compilation attributed to a physician who lived around the sixth century before the common era in the sacred city of Kashi.[1]

This text is from the last centuries before the common era, comparing with the texts of other health sciences of ancient India. It is not religiously bound, as it does not contain the concept of rebirth, nor does it belong to the group of the Sacred scriptures. Written in Sanskrit, it is considered the basic text of surgery and is composed of 127 sections, the most important of which is the "*Nidhanam*." Ayurvedic surgeons, called Dhanvantari, trained under the supervision of renowned experts, by the direct method of observing actions, along with an explanation, and developing academic competence through the application of knowledge in the field. The preparation of a physician or surgeon involved various disciplines such as anatomy, toxicology, and pharmacology. However, surgery was recognized as a craft skill and not as an academic discipline like astronomy or mathematics, which was considered higher because of its interrelation with animating principles.[2]

Ayurvedic surgical instruments are the forerunners of modern surgical instruments, which are designed according to the anatomical aspects of the human body and the principles of surgical procedures, salvaging the patients' lives and alleviating their agonies. The Ayurvedic surgical text describes a variety of surgical instruments that are innovative and inventive. Certain specific instruments and the surgical procedures carried out by these instruments, including cutting, desiccating, extracting, probing, evacuating, suturing, holding, retracting, compressing, dilating, drug administration, bloodletting, and urine voiding, are depicted in the review. The surgical instrumental processes of cutting

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and suturing are addressed by developing specific instruments.[3]

Auxiliary techniques are developed for holding, retracting, desiccating, extracting, evacuating, and inquiry aspects of surgery. In today's surgical practice, these must be reconsidered for a successful effect. The Ayurvedic scholars developed various medicinal instruments and tools that reflect the wealth of their knowledge. The continuous maintenance and improvisation of knowledge are evident to us. With the advent of technology and the adoption of modern systems of medicine, this knowledge should be analyzed, interpreted, and applied so that the complete rational basis of its application can be explored. Since the patient outcome in ancient times was much better due to the combined application of surgical techniques and medicinal therapies from the Ayurvedic knowledge bank, the knowledge presented here must be explored and implemented in the present age with modern system concepts to improve surgical outcomes.[4]

Historical Context of Ayurvedic Surgical Instruments

The historical account of Ayurveda is very vast and cannot be overlooked during the present scenario of modernization. The ancient Indian Ayurvedic science was enriched to a great extent by the different literatures describing the specialized practices of medicine. One such literary compilation contains minute and precise methods of surgical as well as diverse specialties of treatment with their raw materials and solutions. Different metals and metalloids were used in the preparation of various Ayurvedic surgical instruments. Some of the procedures and instruments designed by the ancient sages are still in practice with some modifications that are described according to the demands of the present setup.[5]

These practices, when carefully analyzed, are found to be universally applicable at all times. Unfortunately, this branch of medicine has been overshadowed by the more common and easily understood system of internal medicine, which addresses the majority of medical problems and diseases. Ayurvedic surgery holds the same importance as the other branches of Ayurveda. This represents a school of surgery that is relevant, scientific, and demonstrates techniques of a very high order. Many observations, substantiated by experiments, have greatly influenced the subsequent growth of surgery.[6]

Sushruta: The Father of Surgery in Ayurveda

Ayurveda, the traditional Indian medicine, has been in practice for the last 5000 years. The Atreya school of physicians contributed to the medical practice in Ayurveda. Another school of Atreya, headed by Punarvasu Atreya, influenced the surgical knowledge of Ayurveda. In the Atreya Samhita, Punarvasu Atreya himself cites the school of Sushruta to uphold his surgical knowledge. It is interesting to note that Sushruta pays tribute to Punarvasu Atreya in developing his surgical knowledge. Sushruta himself evolved his surgical school after a deep study of the works of Atreya and Punarvasu Atreya, and hence Sushruta is famed as the disciple of Atreya and Dhanvantari, the disciple of Sushruta.[7]

The Sushruta who is considered the father of surgery in Ayurveda is regarded as a mythical character. The disciples of Sushruta are showered with praise, and hence the famous acharyas, Sushruta and Dhanvantari, are supposed to head the list of benedictions to practice surgery with revitalized morals to acknowledge the Sushruta Samhita and to promote knowledge of surgery. The disciples of Sushruta, namely *Vadhyagura, Charanattikara, Dhannoka, Nishadarna, Kantaradatri, Yajnavalkya, Amrutasastrya, Veetusoplavargvara*, and the bodiless sage of Ayodhya, Maharishi Sushruta, are mentioned with added reverence for their surgical knowledge. The Sushruta Samhita is considered to be the only guide for surgical practice and various other practices of Ayurveda as it stands today since Sushruta derived his knowledge from the Atreya school of medicine and made it a standard work. Sushruta's teachings are assumed to be of universal reappearance for the patients. Some of the surgical instruments used in the Sushruta period and mentioned in the treatise are explained in detail.[8]

Key Ayurvedic Surgical Instruments Described by Sushruta

Ayurveda, meaning science or wisdom of life, is an ancient system of holistic medicine which seeks to help people live in a balanced and attuned way. The *Aṣṭaṅgahṛdayasa* is today recognized in the Indian subcontinent as one of the three main foundational ayurvedic texts. However, it was Sushruta who was the first to describe the use of specific surgical instruments and structural medicine in his compendium, with the most well-known aspects of his classic work being those dealing with rhinoplasty and cataract operations. The information contained in his original compilation of five divisions provides insight into the significant feats of surgery and the associated knowledge of physiology in Ancient India. However, innovation in the field of

surgery regressed and knowledge became fragmented over time. Therefore, a reconstitution of lost knowledge was necessary to introduce and use classical and contemporary procedures in clinical medical practice.[9]

Ayurvedic surgical instruments represent a set of powerful, well-made, and perfectly sharpened tools that are used for incising, abrading, scrapping, puncturing and holding during surgery. The present study carried out by reviewing original and translated versions of the compendium of Sushruta's works helped understand and identify the surgical instruments used during the time of Sushruta, the suitable *Bodhicarya* for each type of instrument, and their role during surgery, respectively. It was found that advanced Ayurvedic surgical instruments were made from certain qualities and combinations of metals and that many of Sushruta's instruments have persisted and are still in use today. The knowledge and experiences exist, live and thrive with intelligence, skill, patience and application. The spirit of Ayurveda encapsulates and embodies the essence of medicine as a whole. The fundamental basis of Ayurveda is the *Viṣaya* or its fundamental principles and philosophies which are congruent with modern and contemporary evidence-based and fact-based protocols found in evidence-based medicine. As a result, the knowledge in the original compendium of Sushruta must remain alive in upcoming generations and should not be allowed to be lost or damaged.[10]

Scalpels and Blades

Scalpels are universally used in surgeries in the current scenario. Sushruta was the first to fashion an entire arsenal of scalpel types. Scalpels are sharpened blades that are honed on both sides and have a sharp pointed end. Various types of scalpels need to be used according to the specific nature of the body tissue that is to be dissected and the surgical operation that is to be performed. Scalpels can be cylindrical, straight, handled, probe- pointed, pointed, arched, crescent-shaped, etc. A surgical scalpel's blade is made up of different materials. There are tools that have been replicated in plastic and steel with one S-shaped or crescent shape that is polished or notched to handle tissues without producing more insertion. The importance of sharpness is critical while creating and selecting the appropriate scalpel form. They have been exposed to the highest level of pre-surgical aseptic preparation and transportation.[11]

Forceps and Clamps

Forceps and clamps are used for different surgical procedures for a wide variety of tissues, such as holding foreign bodies, ulcer debridement, scraping, lithotomy and lithotripsy, fistula tract probing, nasopharyngeal and rectal polyp removal, and other procedures. Most of the descriptions of these instruments are found in the treatment chapters under surgical processes, Shalakya Tantra, orthopedic procedures, and urinary calculi procedures. Only head and cheek holding forceps or specula are described for the external examination of some disease symptoms, such as headache, coma, facial, glandular, tympanic effusions, oral and throat diseases, and inappetence. Specula are also described for oropharynx treatment and eye examination in respective chapters.[12]

These attractively named forceps provide a strong grip, spiking, enclosing cervix surface, and cutting tips close to the grip handle, allowing better access to the region even if the tube is deflected. They offer vision accessories, a flat surface with a subject matter holding groove, fine irrigation, improved visibility, more flexibility, and comfortable holding without damaging roots, tubes, or remaining sharp and solid foreign bodies. The head holder positioned in the upper grip handle part is considered a balanced instrument because it can prevent tissue perforation and minimize backward deflection. It will also be used for tonsil, pharynx, nasal, laryngopharynx, and oral cavity polypectomy, and fistula cure if the surgical experts are experienced and skilled in a head papillary and sinus tumor approach.[13]

Certain instruments provide protection from frivolous abduction. Others are used for removing torsion polyps, nasal gravel, nasal foreign bodies, and nasal secretions. They aim to make the ear chamber visible and stimulate the middle ear site for tumor resection. Various instruments are used for eye diseases, tears, and vision improvement. Some remove foreign body diseases and treat foreign matter in wounds.[14]

Probes and Dilators

Probes hold an important place in the Sushruta Samhita. They are used to explore deep-seated foreign bodies as well as inaccessible regions of the body. Probes are mentioned in detail by various commentators. Sushruta is praised for his judicious employment of probes in numerous conditions, which include the use of salt-hot probes prepared from *Kshara* in *Vibandha*, asthma, *Kaphaja Mutrakrichra, Sandhimukha, and Bandhanamukha*. Pros of various quacks are narrated as they apply sesame seed repeatedly on the affected part; gradually, the swelling is relieved, and as they visualize the site by employing a probe, they apply irrelevant remedies, becoming a *Sañjñána vimukha* temporarily, holding the probe to visualize another site through the sun.

Gradually, they inflict the condition, followed by advice.[15]

In the section titled *'Kaṭimukhauttárana'*, sage Sushruta talks about the procedure to be adopted when the primary surgery goes wrong. In such a case, he says, a small incision may be made, and a probe should be inserted gently in order to widen the mouth so that the resultant wound will take some time to heal, a standstill that is useful. In *Sadyasannirudha*, Sushruta uses a probe in the form of *Snehapatta* to tear the loose attachment of the button and advises the application of a paste of nodding goat's thorn, *Trapsuchcha, Nitrhunli*, black gum, and powdered *Devadala* to arrest the condition and promote granulation of the wound. Shastra graduates use an oil bandage as a medium for threads, with deep insertion of the threads coming out at the end of the wound in conditions like *Kurpara, Sirakshata, Granthi*, and *Steminlibnadha*. Such oil bandages are also utilized in the lifting of the inserted wounds, with the excuse that, over a period of time, the tool of dissection will relax, allowing the lifting of the embedded wounds. Furthermore, various commentaries have pointed out that one should take utmost care while inserting the probe. If these objects are not observed, accidents like injury to neurovascular structures could occur.[16]

Saws and Drills

Saws and Drills: The advantages of metallic instruments in surgery were well known. It was observed that traumatic cut wounds and stab wounds are much simpler to manage than lacerations. The latter are a result of cutting injuries. The possibility of splintering of bone, non-union, slow union, and, at times, complete failure of union were known, as is evident from the treatment section of fractures, but there are no routine precautionary measures for splintering of bone in all fractures. However, in sharp weapons (laceration injuries), it is mentioned that union becomes poor and slow; hence, they should be sutured along with ligature of the vascular bundle. To make the incision smooth so that there is no need for suturing, special tools such as triangular knives and folding knives are used.[17]

As the name implies, the first type of knife is made in the form of an equilateral triangle. The second type is used for making a shallow incision in a piece of skin, kept longitudinally by holding the corners of the blade and pressing with the thumb under the ground edge. The third type of folding knife is held by the vertex of the triangle with the thumbtip and the index finger. The other two corners are kept flat along the skin on either side. In an exposed bone, a cannula is inserted in the most dependent corner. Then the physician gives sharp blows with a mallet on the lower end of the cannula to drill a hole in the bone. The blade is removed from the hole by turning the triangle vertically, the cutting edge facing towards the skin. Then the cannula is extracted by pulling it downwards. Special drill machines are used for glazing wood and boring holes in the bone. The following wooden parts are required for the drill machine: an axis, flywheel or wheel, and cord. There are also other machines such as press, saw, and scale. A rondelet in the form of a horse-bit head is also used for trephining the skull.[18]

Applications and Techniques in Ayurvedic Surgery

In Ayurveda, diseases can be treated with the help of medicinal treatment or with the help of surgical treatment. The surgeries can be understood through methods mentioned for the treatment of specific diseases in the patient. Even the principles like *Bheda, Chedya upayam*, and the usage of different *Shalya Sharira* can help them understand the surgical procedures. Ancient Indian surgeons performed surgeries on such patients through *Shalya* Tantra. The principles and procedures have been appreciated by many people in present medical sciences too. The text explains the wondrous instruments used during that time. The names of surgical instruments are quoted in Ayurveda, like cursor, which is present followed by meaning. Practitioners of Ayurveda state they have performed surgeries with the help of these instruments.[19]

Sushruta and Ashtanga Hridaya explain substantial knowledge on surgical gastroenterology, probably the highest era in ancient human history of exploration. Revolutionary products were made. Surgery can be defined as a testing ground of rationality and practical competence of human science. Indian physicians held surgical skills in high esteem. Sculptures from the Indus Valley Civilization reflect procedures of bladder stone removal. The postulates of surgical management promulgated in works on diseases of the rectum and urine are still unparalleled. Careful examination of the patient, preoperative care, and discussions tailored to variants of treatment methods and instruments were elaborated. His works portray humility and undeviating dedication to the art of surgery through such vast unrivaled studies. A unique bond existed between the mind and intellect of great naturalists with the tools that symbolized their craft. Expertise extended to childbirth as well, being the first to use instruments during difficult childbirth procedures. The *Ashtanga Hridaya* goes on to explain *Marma sthana* and types of *Marma*.[20]

DISCUSSION

Surgical instruments form an integral part of the surgical process, without which surgery cannot be performed. The different effects of internecine weaponry and injury while fighting sometimes necessitated surgical treatment in ancient India. He introduced different kinds of non-cutting surgical instruments, most of them made of metal, to minimize bleeding from accidental cuts. He also designed and developed special instruments to treat different conditions. Some of these instruments, with a new look but with the same fundamental principles of mechanical design, productivity, and utility, are commonly used today in their next generation of smart form.[21]

Ayurvedic surgery came into being as a necessity for mankind after it became civilized and developed urban centers. War became a part and parcel of life in such places, which forced the development of new concepts and the discipline of Ayurvedic surgery. From the different references in ancient texts, we come to know about different surgical instruments and warfare missiles. He is identified as the primary source of origin and development of Ayurvedic surgery, and we can name surgery as Sushruta Samhita, after other scholars of the subject. He mentioned that he himself obtained knowledge of the subject from his teacher and formulated the major goals and principles during his lifetime. He mentions principles and guidelines for surgical procedures, including preoperative and postoperative care. In his work, he describes different surgical instruments, their design and development criteria, and their uses. Several of the issues he tried to address reveal his thorough knowledge of mechanical principles.[19]

CONCLUSION

In this study, a comprehensive overview is presented to give rare insight into antiquarian surgical knowledge, as realized in the innovations of the genius surgeon of ancient India, with special focus on his surgical instruments for the first time. Despite being one of the oldest and most progressive surgical knowledge bases in the antiquarian surgical treasure chest of the world, ancient Indian contributions have so far received a pittance of attention from surgical historians. Modern experimental and translational research in the field of Ayurvedic surgery is sure to revive and resurrect ancient knowledge and wisdom. The legacy of surgical wisdom lives on in the heritage of Ayurveda as it does in these instrument designs. While direct appeals to encourage their practical use are unlikely to meet with success, they can help to promote the preservation, study and appreciation of what remains, after all, an impressive and inspiring aspect of medical-surgical technology. We are grateful to those who compiled these original medical treatises. The surgical treatise is an Ayurvedic treasure, and we have attempted to follow the Sutrasthana, which says: “Scientific inquiry is the pillar of success for the learned; dexterity of hand is the basis of success and extends the physician’s successful practice.” We dedicate this study to the ancient Indian surgeon.

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