

Surgical instruments and endoscopes of Susruta, the sage surgeon of ancient India

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Abstract

Susruta, the great sage surgeon, philosopher and teacher of ancient India, practiced around 600 bc. He is renowned all over the world for his contribution to surgery in general and plastic surgery in particular especially rhinoplasty. But his contribution to endoscopes is not well known to the medical world. His contribution to surgical instruments including endoscopes is reviewed here. Literature survey was the basis of this study. *Susruta samhita* [1], the treatise compiled by Susruta, various commentaries on it by different authors [2, 3] and other related literature are used as primary sources. Susruta belonged to a period between 600 and 800 bc. His conception of surgical instruments, the description of their quality, methods of manufacture and their usage are very unique, as there were no earlier comprehensive descriptions of similar surgical instruments by any surgeon, not only in India but also the whole world. Susruta was perhaps the first surgeon in the world to describe different types of surgical instruments including endoscopes. This is far beyond the imagination of any other surgeon at that period of time and obviously he was far ahead of his time in this field.

Keywords Endoscope · Speculum · Susruta

Introduction

The Greco-Roman antiquity abounds in references to surgery. Ancient Mesopotamians practiced surgery. Sumerians are believed to have used small copper knives for surgical operations around 3000 BC. Mention of some actual surgical operations is found in Hammurabi's code of law (about 1700 BC), in which a knife was used by the doctor to operate on a patient [4]. The ancient Chinese and Japanese cultures were opposed to cutting into human bodies, so surgical operations were not very common in these civilizations.

Surgical instruments were used in ancient Egyptian and other civilizations. Instruments were found depicted on the outer corridor wall of the Kom Ombo temple in Egypt [5]. In November 2001, archeologists in Egypt discovered bronze medical tools such as scalpels, needles and a type of spoon from the tomb of Skar, the oldest Pharaonic surgeon of one of Egypt's Fifth Dynasty rulers dating back more than 4200 years [6]. But Susruta was the first surgeon in the world to describe the surgical instruments and other related subjects in the detailed treatise called *Susruta Samhita*. These instruments include endoscopes like rectal speculum which is used for diagnosis and treatment of hemorrhoids

The earliest reference to the speculum is found in the Babylonian Talmud (BC 1300) [7]. Hippocrates (460–377 BC) had described a rectal speculum [8]. A vaginal speculum was excavated from the house of the surgeon in the Pompeii ruins¹ (79 AD) in Italy [9]. After Talmud, the

¹A thriving ancient Italian city, Pompeii was literally destroyed, and completely buried, during a catastrophic eruption of the volcano Mount Vesuvius in 79 AD. The volcano buried Pompeii under many feet of ash and pumice, and converted the town into a time capsule. It was lost for nearly 1700 years before its accidental rediscovery in 1748. The surgical instruments were found in the house of the surgeon.

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next reference to a speculum is from Susruta's compendium on surgery, *Susruta Samhita*. Susruta has described rectal, nasal, aural and vaginal specula in his treatise. But there is hardly any reference to Susruta's contribution to endoscopes in the medical literature or in the history sections of specialized text books on endoscopy and laparoscopy. Even though Susruta has been extensively studied, researched and published in the medical literature, his contribution to endoscopy in particular is not well known worldwide.

The period of Susruta's practice and of the composition of the book is not known with certainty as is the case with other ancient Indian masterpieces. Susruta is quoted in the Bower Manuscript. This birch-bark medical treatise was unearthed in Kuchar, Eastern Turkistan in February, 1890 and was named after Lieutenant Bower to whom it was sold. Hoernle, an authority on Indology, assigns the date for this manuscript between 350 and 375 AD based on paleographic evidence [10]. Mukhopadhyaya places the period of Susruta between 600 and 1000 BC [11]. Based on the evidence from *Mahabharata and Ramayana*, the two ancient Indian epics and *Atharva Veda*, which is one of the four Vedas (scriptures) of Hinduism, most scholars of ancient Indology placed Susruta in the period between 600 and 800 BC.

Materials and methods

Susruta samhita SAMHITA (from Sanskrit language) means 'a collection of systematically arranged verses' or 'a text'. In ancient India, for easy learning and memorizing, the works of art, science or scriptures were done in verse form, as printing was non-existent at that time. The surgical treatise, *Susruta samhita*, was compiled in verses by the ayurvedic surgeon, Susruta. This text, divided into six sections, describes in detail the various branches of surgery which includes military medicine, medical ethics, teaching methods, dissection of human body, dissection practices and operative surgical exercises on vegetables, and other models like fabric etc. One full chapter (IX of section I) is devoted to principles of experimental surgery. Chapters VII and VIII of Section I give a detailed description of 121 types of surgical instruments. These are classified into two main groups which comprise 101 blunt and 20 sharp instruments. Pictures of some of the instruments including endoscopes are shown in Fig. 1.

The blunt instruments are further classified as follows:

I Blunt instruments (yantras): (Sanskrit name given in parenthesis)	
Cruciform instruments (<i>Svastika yantras</i>)	24
Dissecting forceps or tongs (<i>Sandansha yantras</i>)	2
Spoon shaped instruments (<i>Tala yantras</i>)	2
Tubular instruments (<i>Nadi yantras</i>)	20
Rod like instruments (<i>Shalaka yantras</i>)	28

Accessory instruments (<i>Upa yantras</i>)	25
II Sharp instruments (sastras)	20
Total number of instruments	121

Susruta says that, of all the instruments, hand is verily the most important one, as the instruments are of no use without the use of hand. To be successful in surgery, the surgeon should be well versed with the instruments. He should practice the handling of the instruments before using them on patients.

I. Blunt instruments (yantras)

Cruciform instruments (*Svastika yantras*)

The *Svastika yantras* (forceps) are divided into twenty four sub classes. They resemble the mouths of beasts or birds. They are mainly used for extracting thorn or foreign bodies embedded in bones.

Dissecting forceps or tongs (*Sandansha yantras*)

The *Sandansha yantras* are divided into two classes and are with or without locks. They are used for extracting foreign bodies from skin, muscles, blood vessels and ligaments.

Spoon shaped instruments (*Tala yantras*)

Tala yantras have one or two surfaces resembling the scale of a fish. They are used for extracting foreign bodies from the ear, nose or a sinus.

Tubular instruments (*Nadi yantras*)

Nadi yantras, which are of various types, are used for removing foreign bodies and inspection and treatment of disease spots of external orifices. They are of different diameters and lengths depending on the dimensions of the passage. Endoscopes come under the category of tubular instruments. They are used in piles, fistula in ano, anal stenosis etc. The *arsho yantra* (rectal speculum for piles), *bhagandara yantra* (rectal speculum for fistula in ano) and *yoni vranekshanam* (vaginal speculum) are some of the examples of endoscopes for examination of external body orifices. They are described in detail separately.

Rod like instruments (*Shalaka yantras*)

Shalaka yantras are of several types and are used for different purposes having lengths and circumferences depending on the site of application.

Under this category, eight instruments are divided into four groups. Each group of two have mouths resembling

earthworm, serpent hood, feathered end of an arrow or a hook. They are used for probing, retraction, separation and extraction.

Two have mouths like a half lentil grain and slightly bent at the top, which are used for extracting foreign bodies from passages.

Six are capped with cotton and are used for cleaning.

Three are ladle shaped and mortar mouthed for applying caustic drugs.

Three others have *jambul* fruit (jamun - *Syzygium cumini*) like mouth and three have hook shaped mouth – all the six are meant for cauterization.

One has mouth like half of the nut of kola fruit (a kind of berry) with sharp lips like a mortar and is used for removing nasal polyps.

One has the circumference of a pea nut and both ends are shaped like flower buds and it is used for applying collyrium.

One is meant for cleaning urethra - having length and thickness comparable to the tip of the petiole of *malati* (a kind of jasmine) flower.

Accessory instruments (*Upa yantras*)

These are rope, intertwined thread, bandages, leather straps, bark, creeper, linen cloth, round pebble, stone, hammer, palm and sole, finger, tongue, teeth, nail, mouth, hair, ring of a horse's bridle, twig of a tree, spittoon, evacuating, exhilaration, magnetic stone, caustic, fire cautery and drugs.

II. Sharp instruments (sastras)

1. Circular knife (*Mandalagra sastra*)
2. Bone saw (*Karapatra*)
3. Scalpel (*Vrddhipatra*)
4. Nail parer (*Nakhasastra*)
5. Ring knife (*Mudrika*)
6. Lancet (*Utpalapatra*)
7. Single edged knife (*Ardhadhara*)
8. Suturing needle (*Suci sastra*)
9. Bistoury (*Kusapatra*)
10. Hawk bill scissors (*Atimukha*)
11. Scissors (*Sararimukha*)
12. Curved bistoury (*Amtaramukha*)
13. Three edged knife (*Trikurcaka*)
14. Chisel (*Kutharika*)
15. Trocar (*Vrihimukha*)
16. Awl (*Ara*)
17. Scalpel of different type (*Vetasapatraka*)
18. Sharp hook (*Badisa*)
19. Tooth scaler (*Dantasanku*)
20. Sharp probe (*Esani sastra*)

Sizes of the instruments are given in finger breadths. Instructions for correct handling of the instruments are also given in detail.

Susruta classified surgical operations into eight different categories, *viz.*

1. Excision (*bhedya*)
2. Incision (*chhedya*)
3. Scarification (*lekhyaya*)
4. Puncture (*vedhya*)
5. Probing (*eshya*)
6. Extraction (*aharya*)
7. Drainage (*visravaya*)
8. Suturing (*sivya*)

The sharp instruments and their usage in different types of surgical operations are as follows:

1. Circular knife (*Mandalagra*) and Bone saw (*Karapatra*) are used for excision and Scraping.
2. Scalpel (*Vrddhipatra*), Nail parer (*Nakhasastra*), Ring knife (*Mudrika*), Lancet (*Utpalapatra*, and Single edged knife (*Ardhadhara*) are used for incision and Excision.
3. Bistoury (*Kusapatra*), Hawk bill scissors (*Atimukha*), Scissors (*Sararimukha*), Curved Bistoury (*Amtaramukha*) and Three edged knife (*Trikurcaka*) are used for drainage.
4. Chisel (*Kutharika*), Trocar (*Vrihimukha*), Awl (*Ara*) and Scalpel of different type (*Vetasapatraka*) are used for puncturing.
5. Sharp hook (*Badisa*) and Tooth scaler (*Dantasanku*) are used for extraction of foreign bodies.
6. Sharp probe (*Esani*) is used for probing and as a director.
7. Suturing needle (*Suci*) is used for drainage, puncturing and suturing.

Endoscopes

These instruments are categorized under tubular instruments (*nadi yantra*) of the main group blunt instruments. Tubular instruments are of several types and they are used in a variety of situations. They are used for the examination and treatment of diseased spots of external orifices like ear, nose, mouth, vagina and rectum. They have a hollow interior with an opening at one or both ends. Some have one or two openings on the sides as well. Those with openings at both ends are used for inspection of the throat and extraction of foreign bodies from it. They are also used for aspiration and facilitating surgical operations on external orifices.

Throat speculum

Susruta describes the method of extraction of a foreign body, for example a substance made of lac, from the throat. A heated iron probe or sound should be introduced through

a tube of copper and made to touch the foreign body. The foreign body will melt and stick to the probe. This is then cooled by sprinkling cold water through the speculum and then the foreign body is extracted.

A tubular instrument is also used to blow medicated powder into the nose.

Rectal speculum for piles (Arsho yantra)

Susruta gives a detailed description of this instrument. The instrument may be made of iron, ivory, horn or wood. It resembles the teat of a cow. For male patients, it should be four fingers in length and five fingers in circumference. For

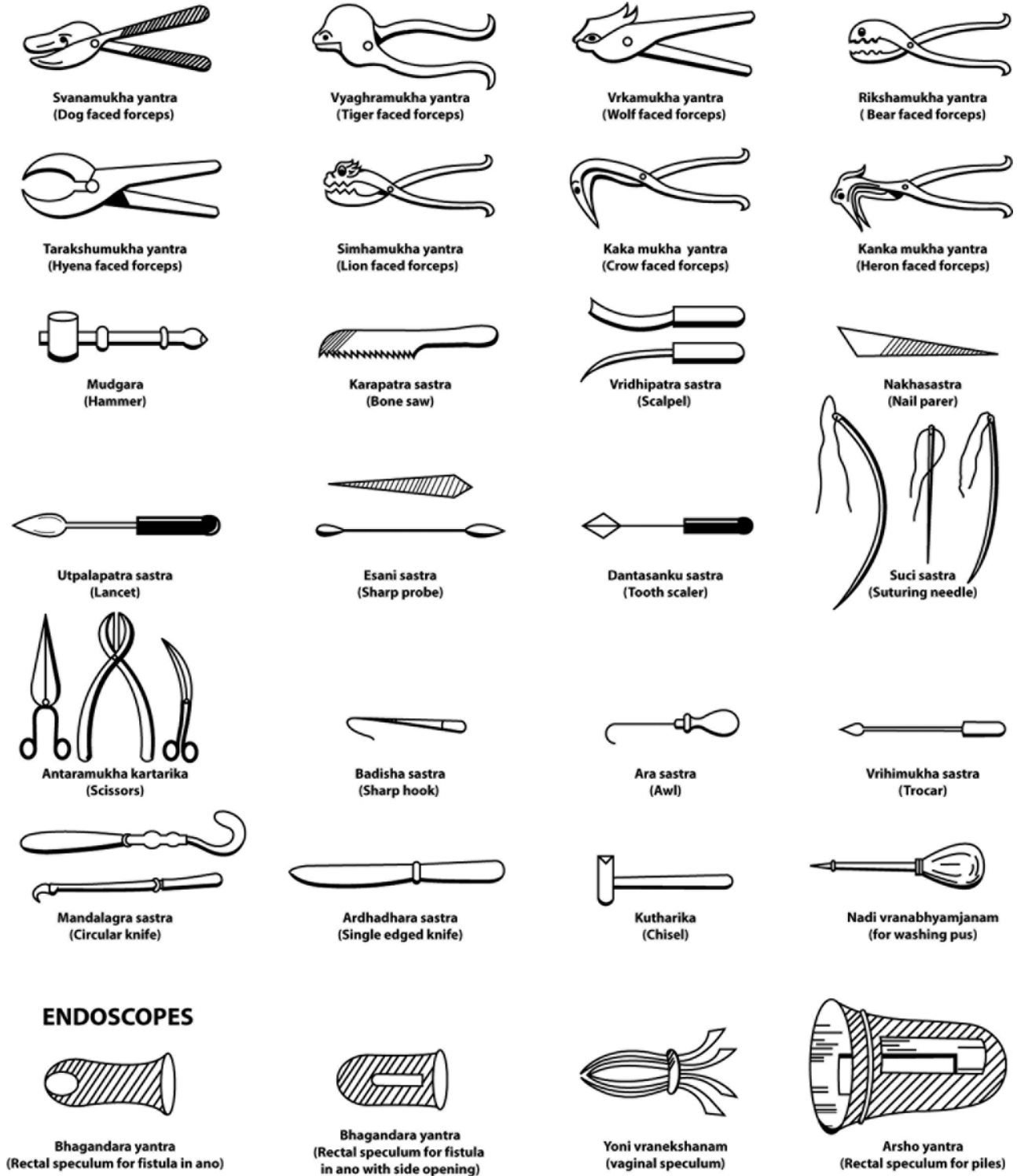


Fig. 1 Pictures of some of the instruments including endoscopes [12].

female patients, the length should be equal to the length of the palm and six fingers in circumference. The instrument should have two apertures, one for inspection of the interior of the rectum and the other for treatment such as cautery of the lesion. The dimensions of the side opening are as follows: three fingers long and circumference equal to the middle of thumb. Half a finger below the outer end (in the remaining one finger length of the instrument), there should be a round ear like circumferential projection of half finger elevation. This elevation prevents excessive movement inwards.

Rectal speculum for Fistula in ano (Bhagandara yantra)

This instrument is similar to the instrument described above for the examination of piles. The only difference is that the elevated ring-like projection near the outer end of the speculum is absent. The projection may rub over the sore area and hence it is omitted in this instrument.

Discussion

Susruta was probably the first surgeon in the world to classify and describe, in detail, the surgical instruments, their method of manufacture, quality control, maintenance and their specific usage in the diagnosis and treatment of diseases. He was also the first surgeon to describe endoscopes such as rectal, aural, nasal and vaginal specula. His contributions should not be viewed based on the current highly and significantly advanced surgery of the 21st century. Yet his contributions are significant to the medical history of the world. As he lived around 600 BC, his surgical treatise should be judged in the light of the state of medicine and surgery which prevailed at that period of time considering the religious taboos and other limitations like the non-existence of high technology manufacturing equipments. With

his exemplary contributions to all the branches of surgery, it is apt to call him the Father of Surgery.

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