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The influence of *Sastra* or sharp surgical instruments proposed by *Acharya susrutha* in the design of modern surgical instruments

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Abstract

Acharya Susrutha is renowned as the first surgeon in the world to schematize surgical instruments and define their qualities, defects, detailed applications in the diagnosis and treatment of diseases, and methods of manufacture and preservation. *Susrutha Samhitha*, which is the major surgical text from the *Vedas*, gives the explanation regarding 101 blunt (*yantra*) and 20 sharp (*sastra*) instruments. It has been observed that most of the surgical instruments of the present day hold astounding resemblance with the ancient surgical instruments. The present paper gives a description regarding the *sastra* or sharp surgical instruments explained by *Acharya Susrutha* and their influence in the design of modern surgical instruments. The study has helped to provide evidence that the basic design of the current surgical instruments might have evolved from the ancient surgical instruments.

Keywords: *Acharya Susrutha*, *Susrutha Samhitha*, *sastra*, surgical instruments

Introduction

Acharya susrutha is renowned all over the world for his contribution to the principles and practices of general and specific surgical measures. The golden age of surgery in ancient India rests largely on the classical Ayurvedic text, *Susrutha Samhitha*. The *Samhitha* gives a list of *Yantra* or blunt (101 numbers) and *Sastra* or sharp (20 numbers) surgical instruments and also suggests that a surgeon, by his own knowledge and cleverness, may devise new instruments to facilitate the performance of the surgical actions. Most of the instruments designed by *Acharya* are having a shape similar to the faces of various birds, animals, parts of plants or certain commonly used armaments. It also seems that most of the modern surgical instruments have astounding resemblance with the surgical instruments designed by *Acharya Susrutha*. The present paper gives a description regarding the influence of the *Sastra* or sharp surgical instruments proposed by *Acharya Susrutha* in the design of modern surgical instruments. The similarities visualized between the ancient and modern varieties also suggest that the basic concept in design might have come from the ancient knowledge. Hence the possible contribution of these ancient surgical instruments to the design of the modern instruments needs to be discovered.

Review of literature

The commentator of *Susrutha Samhitha*, *Acharya Dalhana* explains that the key concept of *Salya tantra* which is one among the eight divisions of *Ayurveda*, is the extraction of *salya* or foreign bodies from the body [1]. The term *salya* denotes not only a piece of wood or grass, but all that which affects or torments the body and mind [1a]. Hence the description regarding the surgical instruments which are the primary means to extract the *salya* from the body, holds a major place in the context of the *Ayurvediya Salya Tantra*.

Acharya Susrutha explains the applications of the sharp instruments in *Sutrastana* 8th chapter named, *Sastravacharaneeyam*. He gives a list of 20 sharp instruments namely, *Mandalagra sastra*, *Karapatra sastra*, *Vrudhipatra sastra*, *Nakhasastra*, *Mudrika*, *Ulpalapatraka sastra*, *Ardhadhara sastra*, *Suchi*, *Kusapatra sastra*, *Atimukha sastra*, *Saraarimukha sastra*, *Antarmukha sastra*, *Trikurchaka sastra*, *Kutarika*, *Vreehimukha sastra*, *Ara sastra*, *Vetasapatraka sastra*, *Badisa sastra*, *Dantasamkhu*, and *Eshani sastra* [1b].

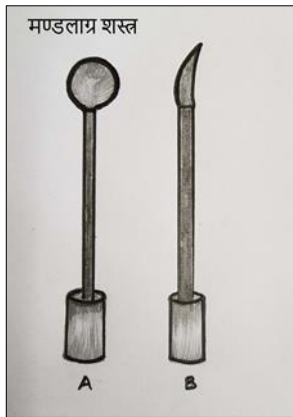
Mandalagra sastra: The shape of the *sastra* has to be assumed from its name that means, it should have rounded edge. This is of two varieties- one with a rounded or circled tip and other with a *Kshura* like tip [1b].

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The term *Kshura* means a razor, razor like barb or a sharp blade attached to an arrow [2]. The *sastra* is used for scrapping and excising the tissues [1c] and both the types have a length of 6 *angula* [1b].

Acharya has explained the instrument for excision of *galashuntika* (tonsil) [1d], for the puncturing of the head of dead foetus in uterus so as to expel it out [1e], for detaching the tissue in the surgical management of the *arma roga* or pterygium [1f] and also for scrapping the hardened vessels in *sirajaala roga* [1g].



Picture 1: A. *Mandalagra sastra* with rounded tip. B. *Mandalagra sastra* with razor like tip

Karapatra (saw): The *patram* or the blade of the *sastra* is like the hand. As a hand which is covered with the fingers, the *sastra* is also covered with or mounted with thorns or spikes [1b]. The *sastra* has the same use as that of *mandalagra*, hence it can be used in scrapping and excising tissues [1c]. The explanation leads to the conclusion that the instrument can be compared with the modern saw. *Acharya* has clearly mentioned that *karapatra* is the only *sastra* which should not have sharp edge as it is used for cutting the bones [1h].



Picture 2: *Karapatra sastra*

Vrudhipatra sastra: The *sastra* is used for *chedana* and *bhedana* (excision and incision) [1c]. According to *Acharya Dalhana*, this *sastra* has its blade resembling the leaf of a plant named *Vrudhi*. The *sastra* is of two varieties, one has a bent tip and other has out-stretched tip. Both are of 7 *angula* length, of which handle or stalk is 5 ½ *angula* and the blade is 1 ½ *angula*. Of these, the bent tipped one is called as *kshura* [1b]. In *Ashtanga hrudaya* it is explained that the *vrudhipatra sastra* is like a razor used by the barbers and is used for excising, incising and cutting the lesions [3]. The plant *vrudhi* is one among the *Ashtavarga*. Its botanical name is *Habenaria edgeworthii*.

Acharya Susrutha explains the usage of the *kshura* or the razor along with scissors and forceps for removing the hairs from wounds which are difficult to heal because of the presence of hairs [1i], in the treatment of curable cases of spider bites for excising the bitten part [1j] and in the surgical treatment of scrotal enlargements caused by *medas* [1k].

Among the modern instruments, *vrudhipatra sastra* can be correlated with the ordinary scalpel and knife.

Nakhasastra (nail parer): The *sastra* is used for *chedana* and *bhedana* (excision and incision) [1c]. *Acharya Dalhana* explains that the *sastra* is used for cutting the nails. The blade of the *sastra* is 2 *angula* long and one *angula* broad [1b].

Mudrika: The *sastra* which is used for *chedana* and *bhedana* is 6 *angula* long [1c]. *Vagbhatacharya* has given another name for the *sastra* as “*angulisastra*”. This *sastra* has a ring from which extends the blade which is ½ *angula* long. The blade is similar to *vrudhipatra* or *mandalagra sastra* in appearance and function. The *sastra* which is to be worn at the distal interphalangeal joint of the index finger should be secured to the wrist of the surgeon by thread. This is used for excising and incising the lesions inside the throat [3a].



Picture 3: *Mudrika sastra*

Ulpalapatraka sastra: The *sastra*, *Ulpalapatraka* is used for excising, incising, scrapping and puncturing the lesions. The shape of the blade of the *sastra* is like that of the *patraka* of the plant *ulpala* [1b, 1c]. The term *ulpala* means blue lotus (*Nymphaea caerulea*) [2a]. Blue lotus is also known as blue water lily. The term “*patraka*” here refers not to the leaves but to the flowers of the plant. The petals of the flowers are oval in shape with pointed edge. Thus, it can be assumed that the blade of the *sastra* resembles the petals of blue water lily plant.

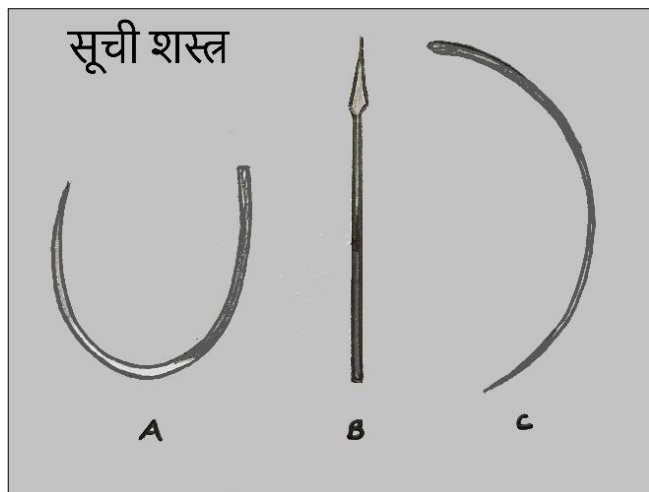
Ardhadhara sastra: The *sastra* has the same usage as the *Ulpalapatraka* and used for excision, incision, puncturing and scrapping of lesions. The *sastra* is 8 *angula* long and the blade is only on one half (compared to *ulpalapatraka* which has double blade) and bent or curved. The blade is one *angula* wide in the central part and 2 *angula* long [1b].

Suchi sastra: *Suchi sastra* is used for draining out of pus like materials, for puncturing the deep-seated edematous lesions and for suturing [1c]. Three types of *suchi* described in *Susrutha samhitha* are:

1. For areas with less musculature and in joint areas – *suchi* should be *vritha* (rounded) and two *angula* long (Picture 4- A).
2. For fleshy areas, the *suchi* should be three *angula* long and possess three edges at the tip (Picture 4- B).
3. For *marma* regions, *phala kosha* (scrotum) and abdomen, it should be curved like a bow (*dhanurvakra*) (Picture 4- C).

All the three types should be *theekshnagra* (sharp-tipped), well-furnished and made by a skillful or clever person. The circumference of the body of the *suchi* should be same as that of the tip of the pedicel of jasmine flower [1l].

The *suchi* is used for puncturing the thin ear lobe of a child for ornamentation and protection ^[1m] and also for puncturing the sides of the cornea for draining out the fluid in disease named *Ajaka* ^[1n].



Picture 4: Three types of Suchi sastra

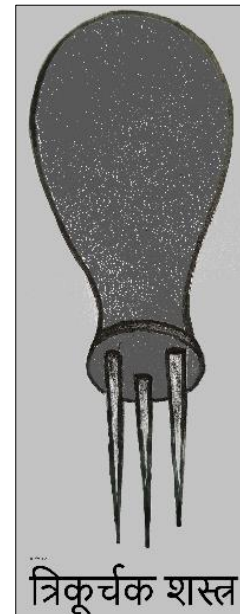
Kusapatra sastra: The *sastra* is used for drainage and puncturing of the lesions ^[1c]. Its blade resembles a *kusa patra* and has a length of 3 *angula*. The *sastra* has a ring-like ornamentation measuring 2 *angula* and a handle of 3 *angula*. The handle lies in between the blade and ring ^[1b]. The term “*kusa*” means the sacred grass used in religious ceremonies, *Poa Cynosuroides*, a grass with long pointed stalks ^[2b].

Atimukha sastra: *Atimukha sastra* is used for *visravana* (draining of lesions) ^[1c]. The “*ati*” or “*ata*” is the name of *jalavardhini bird*, which is correlated as *Turdus Ginginianus* ^[2c]. The *sastra* has a mouth or tip resembling the face or bill of the bird. The stalk or handle of the *sastra* is 7 *angula* and the blade at the tip, having the shape of the face of the bird is as wide as a thumb ^[1b].

Saraarimukha sastra: The *sastra* is used for drainage of pus like lesions ^[1c]. *Acharya Dalhana* quotes that the tip of the *sastra* is shaped like the face of the bird *saraari*, which is having very long beaks. There are two varieties of the bird—one with white coloured shoulder region and the other with red coloured head region. The bird with white shoulders should be considered here. This *sastra* also renowned as *Karthari*, is 12 *angula* long and is with a moving joint ^[1c]. The term “*karthari*” means scissors, knife or any instrument used for cutting ^[2d]. The term “*saraari*” has another synonym as *saraali bird* and it is correlated as heron bird ^[2e]. Hence it can be assumed that the tip of the *sastra* is shaped like the beak of heron bird.

Antarmukha sastra: This *sastra* is used for drainage ^[1c]. The term *Antarmukha* denotes that the *sastra* has its mouth in the middle or centre. Its length is 8 *angula* and has curved blades like a half moon or semicircular ^[1b].

Trikurchaka sastra: The *sastra* is used for draining of pus like discharges in children, aged, delicate, timid patients, women and royal persons ^[1o]. This *sastra* has three edges or needles (*three kurcha*) ^[1b]. Each of the needle is one *angula* long and shaped like the *antarmukha sastra*. The distance between the blades is that of the size of a *vreehi dhanya* (paddy seed). The handle is 5 *angula* long and decorated with a ring ^[1b].



Picture 5: Trikurchaka sastra

Kutarika sastra: According to *Acharya Dalhana*, the instrument which is used for puncturing, is similar to an axe. *Acharya* also quotes that the *sastra* has a handle which is 7 ½ *angula* long. The blade is ½ *angula* long and shaped like a cow’s teeth ^[1b].

Vreehimukha sastra: The instrument is used for puncturing purpose ^[1c]. Its length is 6 *angula* and the shape of the blade is similar to that of the *vreehi dhanya* or the paddy seed ^[1b]. The *sastra* is mentioned by *Acharya Susrutha* while dealing with the surgical measure in *Udakodara* ^[1p] (ascites) and for puncturing below and to the sides of the raphe in scrotal enlargements caused due to urine ^[1q].

Ara sastra: The *sastra* used for puncturing, has a shape similar to the instrument *Ara* which is a *sastra* used by leather workers or shoemakers ^[1b]. The term *ara* means a sting, shoemaker’s awl or knife ^[2f]. The handle of the *sastra* has same thickness of the flower bud of the *Durva* grass and is similar in shape to a cow’s tail ^[1b]. The *durva* grass is the bent grass or panic grass (*Panicum Dactylon*) ^[2g]. *Acharya Dalhana* has explained the use of this *sastra* in the treatment of crushed nails ^[1r]. The *ara sastra* is also advised for the puncturing of the thick earlobes of a child for protection and ornamentation^{1m} and for puncturing the bones in treatment of obstructed *vathadosha* inside the bones ^[1s].

Vetasapatraka sastra: The *sastra* is 6 *angula* long and used for puncturing ^[1b, 1c]. *Acharya Dalhana* comments that the *sastra* is having a blade similar in shape to a *vetasa patraka* ^[1b]. The term “*vetasa*” means, the rattan (*Calamus Rotang*) or a similar kind of cane, a reed, rod or stick ^[2b]. Hence the edge of the *sastra* is assumed to have a shape similar to the leaflets (*patraka*) of the plant.

Badisa sastra: The *sastra* is used for extraction and has sharp pointed spine like tip which is bent and is of 6 *angula* length ^[1b, 1c]. As the name implies, the *sastra* is shaped like the *badisa* or fish hook which is used for puncturing fish. *Acharya Susrutha* has described the use of *badisa sastra* in the treatment of *asmari* ^[1t], in the extraction of boils named *Uthama* ^[1u], in the context of the treatment of the eye disease

named as *arma* ^[1v] and for holding the *mandalagra sastra* while it is being used for scrapping the hardened vessels in *sirajaala roga* ^[1w].

Danta samkhu: The *sastra* is used for extraction ^[1c]. This instrument which is like a spear or spike is used for removing tartar like impurities from the teeth ^[1b]. The use of a *sastra* is said in the treatment of the diseases of the gums like *dantavaidarbha*, for the extraction of *adhimamsa danta roga* ^[1x], and for excising the gums in the disease named *danta nadi* ^[1y]. As the region of surgical application in these diseases is the gums, it can be assumed that the *sastra* mentioned is *danta samkhu*.

Eshani sastra: The *sastra* is used for probing and drainage and hence should have a pointed tip ^[1c]. *Susrutha* has described the use of the *sastra* in *visarpa nadee sthana roga* treatment. It is advised to search the track with *eshani sastra* before introducing the *suchi* with the *kshara sutra* ^[1z].

Observations and discussions

In the description of the shapes of the *sastra*, *Acharya* has quoted resemblances to the bills of birds in two cases- *Atimukha sastra* and *Saraarimukha sastra*. In other cases, he has compared the *sastra* to certain plant parts (eg- *vreehimukha*, *vetasapatraka*) and to some common instruments used by the workers like barbers and wood cutters (eg: - *ara*, *kutarika*). In the case of design of *sastra*, the keen observation of the nature by our ancient *Acharyas* and the adoption of non-harming, user-friendly techniques can be noted.

Representing the human as a miniature form of the universe and comparing all the bodily aspects with that of the natural phenomena was the concept behind most of the theories framed by the ancient scholars. The ancient *Ayurveda* Scholars also adopted the same vision for most of their basic principles and this view can be visualized in the design of *sastra* also. The keen observation of the nature enabled the *Acharya* to utilize the natural principles in the framing of *sastra* for surgical procedures. This can be seen in the incorporation of axe, saw, scissors, spear etc. like commonly used armaments into the list of surgical instruments. Likewise observing the bird's behavior in using their bills for feeding and various other manipulations, the similar technique is incorporated into the shape of the *sastra* so as to make them suitable for various surgical operations like puncturing and draining lesions.

The apt lengths prescribed for the various *sastra* makes them user-friendly by minimizing the efforts to the surgeon and harm to the patients. The razor like sharpness which is the main feature of the *sastra* (except *karapatra*) makes the *sastra* precise in action by minimizing discomfort to the patients. A proper handle, excellent metallic finish, sharp edges, attractive appearance, properly united tip and base and

absence of dreadful impression are considered as the good features of a *sastra* by *Acharya* ^[1aa]. Whereas, rounded or bent, blunt, incomplete and rough edges, excessive thickness, tininess, excessive or deficient lengths are said to be the eight demerits of a *sastra* ^[1ab]. All these point to the non-harming and user-friendly techniques adopted by *Acharya* in the design.

It is noted here that *Acharya* has used an interesting method of measurement named as *Angula* for denoting the measurements of the *sastra*. It is the unit of linear measurements used in *Ayurveda* ^[4]. *Angula* is a personalized measurement which differs from individual to individual and the appropriate correlation of one *angula* in terms of modern units of length cannot be provided. Instead of treating this as a standard measurement, *Acharya* measures the body of the person concerned in terms of this distance in the person's own hand, irrespective of him being a man, woman or a child. Hence the value will remain the same even if the person is well grown or not, irrespective of his age ^[5].

It has been observed by both modern practitioners and Ayurvedic experts of the present era that there exists a strong similarity in the shapes of modern surgical instruments and the ancient instruments proposed by *Acharya Susrutha*. Several instances are observed in the present study that suggested that the instruments projected by *Susrutha* in his *Samhitha* had influenced the design of the modern surgical instruments. The differences encountered between the two may be in terminologies or in materials used only. The similarities visualized between the ancient and modern varieties also suggest that the basic concept in design might have come from the ancient knowledge.

The influence of the surgical instruments designed by *Acharya Susrutha* on modern surgical instruments can be pictured in various aspects.

1. Nomenclature of the instruments—*Acharya* has proposed the names of the instruments based on various criteria

- Resemblance to objects in the surroundings eg:- *kutarika*, *arasastra*
- Procedures done eg:- *eshani sastra*
- Shape of the operating ends- *atimukha sastra*, *mandalagra sastra*
- Region where used- eg:- *nakha sastra*, *danta samkhu*

This method of naming the instruments is also prevalent among modern surgical instruments. Examples: mosquito artery forceps, crocodile punch biopsy forceps, amputation saw, ascitic tap etc.

2. Shape of the instruments

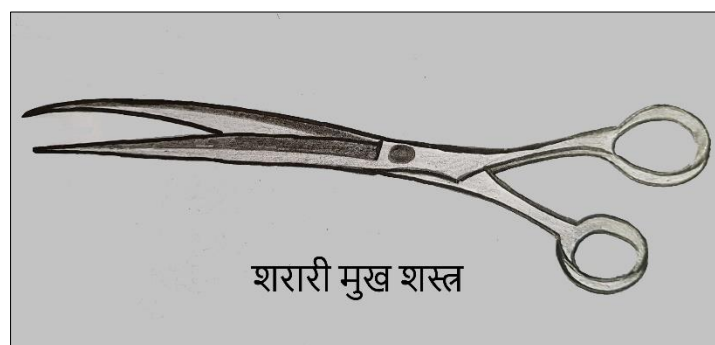
The various surgical knives of the present period have striking resemblance with the two varieties of the *mandalagra sastra*, *vrudhipatra sastra*, *ardhadhara sastra*, *kusapatra sastra* and *ulpalapatraka sastra*.

Table 1: Comparison between ancient and modern varieties of surgical knives

 <p>वृद्धि पत्र शस्त्र</p>	
 <p>अर्द्धधारा शस्त्र</p>	
 <p>कुश पत्र शस्त्र</p>	
 <p>उल्पल पत्रक शस्त्र</p>	
<p>Ancient surgical instruments</p>	<p>Modern surgical instruments</p>

The long scissors of the present day and the *saraarimukha sastra* has striking resemblance and both are used for cutting.

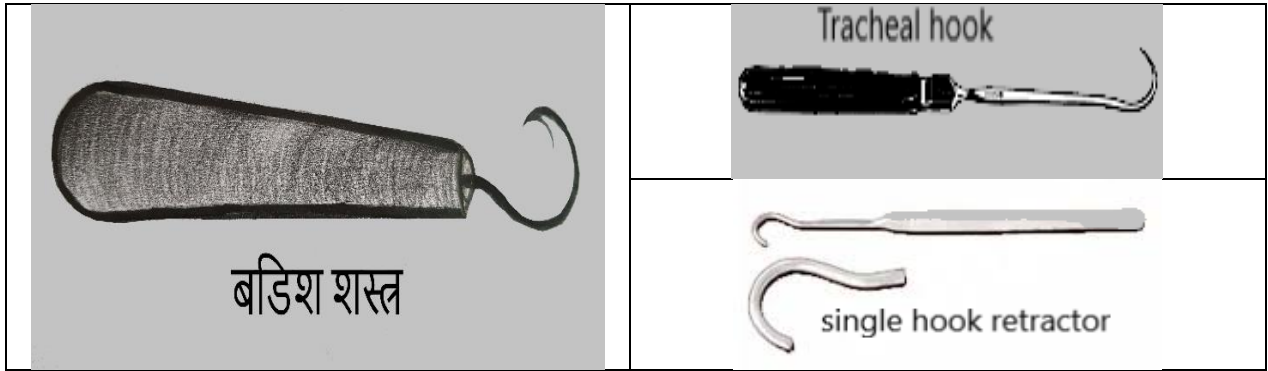
The sharp pointed scissors are used for cutting of sutures in modern surgery.



Picture 6: *Saraarimukha sastra*

The blunt and sharp tracheal hook used for tracheostomy resemble *badisa sastra*. The retractors like the single hook retractor used to retract the skin edges while suturing also resembles *badisa sastra* (Table 2). The nerve hook is a small

delicate instrument with sharp hook at the tip, helps to retract and lift the nerves during surgeries. This instrument also resembles a *badisa sastra*.

Table 2: Comparison between *badisa sastra* and tracheal hook and single hook retractor

The antral trocar and canula used for the puncture of the roof of the maxillary sinus in the treatment of sinusitis resembles *ara sastra*. The trocar and canula used for hydrocele also resemble the *ara sastra*.

The amputation saw among the modern surgical instruments is similar in shape to the *Karapatra sastra*.

The Bard Parker knife handle with detachable blade used for skin incisions in modern surgery holds strong similarity in shape with the *Ardhadhara sastra*.

The curved needles (half circle curved, full circle curved or 5/8 circle curved) which are used in modern surgical practices are similar to the rounded and bow shaped *suchi sastra*. The cutting types of the modern needles possess a triangular cross section like the *Suchi sastra* of three edges. The Jobson's aural probe is a slender probe having a serrated end and a ring end. This also holds resemblance with the *suchi sastra*.

The beer knife which is a sharp pointed knife used for incising the lid and tarsal plate of the eye has a triangular outline like the *atimukha sastra*.

Conclusion

Ancient *Acharyas* had contributed to the development of the science by adding their knowledge which they acquired through previous experiences, keen observation of the surroundings and active experimentations. An outstanding success of *Susrutha* tradition lies in the design, development and appropriate use of a rich surgical armamentarium⁶. It is the keen observation of the nature by *Acharya* which made it possible for him to utilize natural phenomena for the design of the *yantra* and *sastra*. The ethical value of the surgical instruments has also been maintained by *Acharya* in their creation and uses. The present study also revealed that there are remarkable resemblances in the shapes and functions of the sharp instruments proposed by *Acharya Susrutha* and modern surgical instruments and this similarity cannot be considered as accidental. The study thus helped to establish the contribution of the ancient surgical instruments proposed by *Acharya Susrutha* to the design of the modern instruments.

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