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REVIEW OF CLASSIFICATION OF SUSHRUTOKTA YANTRAS IN THE LIGHT OF LEVER THEORY

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ABSTRACT :

Sushruta samhta is the ocean of knowledge. It is a basic guideline, which provides us the light to remove the darkness of ignorance. The understanding of surgical instruments, their designing, their use, their importance and maintenance are developed in *Yantravidhi adhyaya.* A comparative study was conducted on the basic fundamental of *yantras* and Archimedes theory of Lever. It can be concluded that *Sushruta* had given the earliest description of fulcrum in the reference of surgical instruments.

Key words: *Yantra*, *Shalya*, lever, fulcrum.

INTRODUCTION:*Acharya sushruta* has described *yantras* or surgical instruments in his seventh chapter of *sutra sthana i.e. Yantravidhi adhyaya*. History depicts that this text belongs to as early as 2000 BC. The *Yantras* are defined as any mechanism necessary to remove the *shalya* (i.e. foreign body) from the human body. The word *Shalya*, itself is used in broader term by *Sushruta*. According to him, anything that causes discomfort in human body (*sharir*) or human mind (*mana*) is *shalya* [1]. *Shalya* may be *trina, kashtha, pashana, panshu, loha, loshtha, asthi, baal, nakha, puya, srawa, dushta vrana and antah garbh* [2]. *Yantras* are to be used for removal of *shalya* in those wounds which are deep seated, having narrow opening, foreign body (*shalya*) containing and where manual removal of *shalya* is not possible [3]. Modern surgical instruments are more similar to the ancient *Yantras, even in their names*. Many of the studies, regarding comparison, accreditation and review, between old and new have been conducted so far. But, the scientific philosophy of *Sushruta* is yet undiscovered. The present study is a bridge to fill the gap between the traditional and modern crafting and designing of instruments.

MATERIAL AND METHOD: The text related to the description of *yantras* in *Sushuta Samhita* was reviewed and the search was made on the internet for the related research studies in this reference. The authentic and allied research works were compared. The bona fide articles on Lever theory were also reviewed this reference.

***Sushruta's* Classification of Instruments:**

He has described 101 *yantra* or blunt surgical instrument in major six categories.

1.	*Swastika yantra*	24
2.	*Sandansh yantra*	2
3.	*Taala yantra*	2
4.	*Nadi yantra*	20
5.	*Shalaka yantra*	28
6.	*Upa yantra*	25
Total		101

Swastik yantras are more alike cruciform instruments, which are attached in the center with the help of keel. Mouths of *swastika yantras* are like carnivorous animals and birds. *Sushruta* has given a common term *keel* i.e. pivot or fulcrum in the description of *swastika*, *sandansha* and

taal yantras. *Swastik yantras* are used to remove *shalyas* from *asthi*. *Sandansh yantras* are V-shaped forceps, which are meant to remove *shalya* from *twak*, *mansa*, *sira* and *snayu*. *Sandansha yantras* are the first form of the modern surgeon's spring forceps, dissection and dressing forceps. Diagnostic instruments like *nadi yantras* and their principle were first laid down by *Sushruta*, which took several modifications with advent of technology to attain present form of Endoscopes [4]. *Taal yantras* are like scoop, used in *shalya aharana* from *karna*, *nasa* and *nadi* [5]. Each and every surgical procedure is planned and systematic use of *yantras* (blunt) and *Shastras* (sharp instruments) [6].

Fulcrum or lever theory:

A lever is a machine consisting of a beam or rigid rod pivoted at a fixed hinge or fulcrum. A lever amplifies an input force to give a greater output force, which is said to supply leverage. The ratio of the output force to the input force is the mechanical advantage of the lever. The earliest remaining writings regarding levers date from the 3rd century BC and were provided by Archimedes. "Give me a place to stand on, and I will move the Earth" expresses his recognition that there was no limit to the amount of force amplification that could be achieved by using mechanical advantage [7].

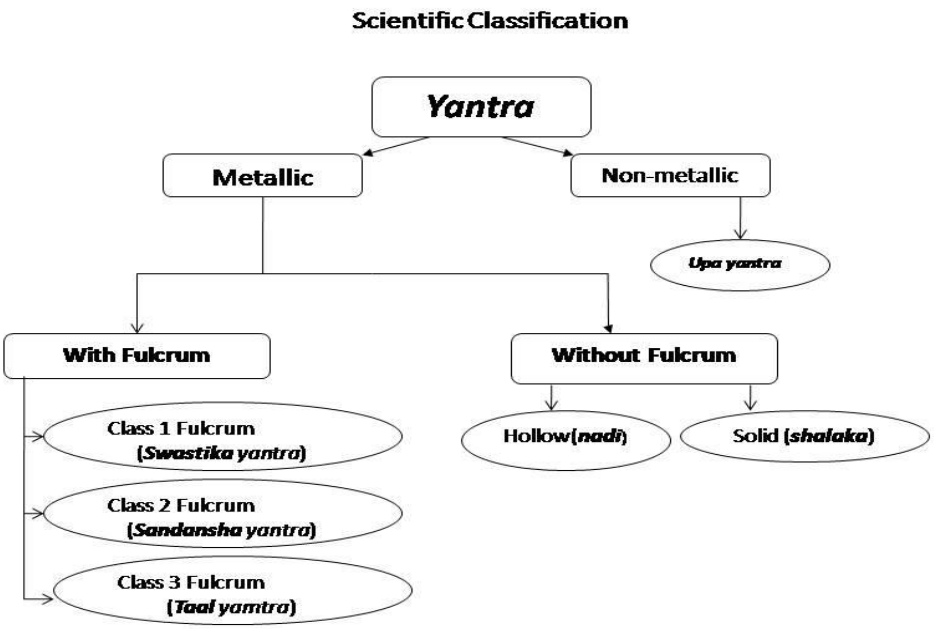
Levers are classified by the relative positions of the fulcrum and the input and output forces. The input force is called as effort and the output force is called as, load or resistance. This allows the identification of three classes of levers by the relative locations of the fulcrum, the resistance and the effort [8].

- **Class 1**: Fulcrum in the middle. The effort is applied on one side of the fulcrum and the resistance on the other side e.g., a seesaw. Mechanical advantage may be greater or less than 1.
- **Class 2**: Resistance in the middle. The effort is applied on one side of the resistance and the fulcrum is located on the other side e.g., nut cracker a bottle opener. Mechanical advantage is always greater than 1.
- **Class 3**: Effort in the middle. The resistance is on one side of the effort and the fulcrum is located on the other side e.g. the human mandable. Mechanical advantage is always less than 1.

Review of *Sushruta's* Classification of *Yantras:*

Sushruta's classification can be more elaborated as basic two types of instruments. First, metallic and another one are non-metallic. *Upa yantra*, non-metallic instruments are meant for the same purpose of surgical procedures in the absence of those more sophisticated metallic one. Metallic instruments should be made up of good quality of metal (iron) by expert designers. Metallic instruments can be further classified into two type's viz. with fulcrum and without fulcrum. *Nadi yantra* (hollow) and *shalaka yantra* (solid) are tubular in shape and are used for non-mechanical work, like visualization, probing, suction, drug application etc. Both of them have no fulcrum and are designed and used according to their nature of work

Figure 1:



The first machine or *yantra* which was discovered by human was wheel and then fulcrum or lever. Machine may be any device that reduces human effort up to some extent and both above are basic structure of any machine. *Sushruta* has given first of all a clear cut description of machine in terms of *yantras*. *Sushruta* has given a common term *keel* i.e. pivot or fulcrum. Further, he classified them in sub-group of *Swastika*, *sandansha* and *taal yantra*, which was latter elaborated by Archimedes as Class I, Class II and Class III Lever.

Mouths of swastika yantras are like carnivorous animals and birds. It is more interesting that, the dental formulas of such animals are designed by nature so that they can easily and firmly grasp their prey. The muscular structure of their jaw gives the much more power to clasp. Jaw itself is an example of class 3 lever.

Why Hand is the best Instrument?:*Sushruta* has remarked "Hand is the best instrument" in the beginning of *"yantra vidhi adhyaya*" [9]. Why? He gave the explanation that all the instruments are subsidiary to hand. All manmade instruments have a limited degree of freedom. They can move and work only in two dimensions.While, "hand"has three dimensional range or degree of freedom of movement.It is scientifically accepted that no machine is as better as human hand. In spite of discovery of robotic arm, the tactile and other sensations,are big challenge to robotics, which was given by *Sushuruta* that "*Hastmeva pradhantamam yantranam ".*

CONCLUSION:

It can be concluded that *Acharya sushruta* was not only the "Father of Indian Surgery" but also he had a great knowledge of engineering science. We can depict him also as "Father of Machine", as he gave the basic concept of machine, its classification, and their proper use.

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