

VALUABLE HIDDEN TREASURES OF ANATOMY DESCRIBED IN AYURVEDA AND
ITS REVIEW IN MODERN SCIENCEDr. Deepa¹, Dr. Bhanu Pratap Singh², Dr. Vikash Bhatnagar³ and Dr. Sandeep M. Lahange⁴¹M.D. (Sharira Rachana), Medical officer, Rajasthan.²MD Scholar, Dept. of *Sharira Kriya*, National Institute of Ayurveda, Jaipur.³Assistant Professor, Dept. of *Sharir Rachana*, NIA, Jaipur.⁴Assistant Professor, Dept. of *Sharir Rachana*, NIA, Jaipur.

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ABSTRACT

Anatomy is broadly appreciated as being one of the cornerstones of medical education. If we go through the history of human anatomy it seems that anatomy of modern times is well recognised from the days of renaissance that is from 15th century. Medical Science was one area where surprising advances had been made in ancient times in India. Specifically these advances were in the areas of human dissection, embryology, plastic surgery, extraction of cataracts, description of *Asthi*, *sandhi*, *peshi*, *snayu*, *marma* and *Pramana sharira* etc. These are not just claims. There are documentary evidences to prove the existence of these practices. *Acharya Sushruta* has paid great attention towards the structural organization of the human body. This was emphasized to such an extent that no surgeon should start his surgical carrier unless he is well aware with human anatomy. *Acharya Charaka* also studied the anatomy of the human body and various organs. He also described the numbers of muscles, joints etc. in human body. The object of present study is to trace out the most significant and valuable hidden treasures of anatomy practiced in the past by *Acharya* and its review in Modern Science.

KEYWORDS: Anatomy, *Asthi*, *Marma*.

INTRODUCTION

Anatomy is broadly appreciated as being one of the cornerstones of medical education. If we go through the history of human anatomy it seems that anatomy of modern times is well recognised from the days of renaissance that is from 15th century. The foundation stone of modern anatomy is the work of Andreas Vesalius: *De Fabrica Corporis Humani*, published in 1543.

Sushruta is considered as the father of surgery even today, but if we go through the *Ayurveda* text, essentials of human anatomy are very precisely described by *Sushruta*, so he should also considered as the father of human anatomy. *Acharya Sushruta* has paid great attention towards the structural organization of the human body. This was emphasized to such an extent that no surgeon should start his surgical carrier unless he is well aware with human anatomy. *Acharya Charaka* also studied the anatomy of the human body and various organs. He also described the numbers of muscles, joints etc. in human body.

AIMS AND OBJECTIVES

To explore and analyze the text books of *Ayurveda* to find the fundamentals of human anatomy and its relevance in Modern Science.

MATERIALS AND METHODS

References related to proposed title are collected from classical texts of *Ayurveda* especially *Brihatrayi*. Various publications, internet, books related to the modern anatomy, research papers related to the topic are collected.

REVIEW OF AYURVEDIC LITERATURE

In this context some basic concepts are described to show that scientific knowledge of human anatomy was very well known to our *Acharya*. These are following:

***Shadanga sharira* (Concept of regional anatomy)**

Charaka and *Sushruta* have divided the human body into six following regions - two upper extremities, two lower extremities, head and neck and trunk.^[1,2] *Acharya Vagbhatta* has also said that head, trunk, two arms and two legs are in brief the six *Anga* of the body.^[3]

Asthi sharira (Concept of Osteology)

Sushruta has described the importance of *Asthi* that how these are the major supporting framework of our body and he also mentioned their types with their examples. He told that just as the tree remains firm on the ground by their inert wood; similarly the body remains in erect position by the support of the *Asthi* inside it. Though the skin and muscles get destroyed after some time, *Asthi* do not get destroyed since these are the *Sara* (essence) of the body.^[4]

Asthi prakara (Type of bones)

These *Asthi* are of five kinds. These are as follows - *Kapala* (flat), *Rucaka*, *Taruna* (cartilage), *Valaya* (curve) and *Nalaka* (tubular) *Asthi*. Out of these *Kapala asthi* are found in the knee, pelvis, scapula, cheek, palate, temple and head; *Rucaka asthi* are the teeth; *Taruna asthi* are found in the nose, ear, neck and the eye orbit; *Valaya asthi* are found in the flanks, the back and the thorax and the rest of the *Asthi* are the *Nalaka asthi*.^[5]

Asthi Sankhya (Number of bones)

According to the followers of *Vedas*, there are three hundred and sixty *Asthi* in the body; but in the *Shalya tantra* only three hundred *Asthi* are recognised. Out of these one hundred and twenty *Asthi* are found in the extremities, one hundred and seventeen in the pelvis, flank, back and the thorax and sixty three in the region above the neck. In this way the total of three hundred *Asthi* are completed.^[6]

Sandhi sharira (Concept of syndesmology)

The *Sandhi* are of two types- *Chala* (movable) and *Achala* (immovable). The movable joints are found in extremities, mandible and hip. All other joints should be considered as immovable.^[7]

Description of Peshi (Myology)

Acharya Sushruta has described about the *Peshi* in *Sharira sthana* - *Peshi* are thick or thin, big or minute, stout/thick or round/circular, short or long, fix/stable, hard or soft, smooth or rough; they cover the *Sandhi*, *asthi*, *sira* and *Snayu*, in their places naturally.^[8]

Description of Snayu (Ligament)

Sushruta has told that as a boat prepared by joining firmly many wooden planks is able to bear the weight of persons in the water, similarly all the *Sandhi* of the body bound by many *Snayu* are able to sustain body weight. Injury to *Asthi*, *peshi*, *sira* and *Sandhi* does not cause as much disability as an injury to the *Snayu*.^[9]

Pramana sharira (Concept of Anthropometry)

According to *Sushruta*- The measures have been described with one's own *Angula* (Fingers) as the yardstick. The male or female, possessing all these standard criteria will be having healthy and disease free life. Among them those having medium proportions will have moderate life expectancy and wealth while one of inferior proportion is poor in both.^[10]

According to *Charaka*- The measurements of the body are described by the measures of individual *Angula* in terms of height, breadth and length respectively. Thus measurements of the body parts are discussed separately. The entire body measures eighty four *Angula* in height and also in breadth. The persons having normal measurement of the body will possess longevity, strength, immunity, happiness, supremacy, wealth and other desired qualities. Those having body with less or more measurements have qualities contrary to these.^[11]

Description of Marma (Vital points)

There are one hundred and seven *Marmas*. These *Marma* are of five types. They are as follows: *Marma* are located in the *Mamsa* (muscles), *Sira* (vessels), *Snayu* (ligaments), *Asthi* (bones) and *Sandhi* (joints).^[12]

These are classified into five groups as *Sadhya pranahara* (instantly fatal), *Kalantara pranahara* (fatal after a time), *Vishalyaghna* (fatal on extraction of foreign body), *Vaikalyakara* (disabling) and *Rujakara* (painful). Nineteen are *Sadhya pranahara*, thirty three are *Kalantara pranahara*, three are *Vishalyaghna*, forty four are *Vaikalyakara* and eight are *Rujakara marma*.^[13]

The areas where *Mamsa*, *sira*, *snayu*, *asthi* and *Sandhi* meet together are known as *Marma*, which by their virtue of nature are specially the sites of *Prana* (life). Therefore, an injury to any one of the *Marma* invariably produces characteristic features.^[14]

Injury to *Sadhya pranahara marma* kills within a week. The *Kalantara pranahara marma* kills within a fortnight or a month. Out of these, injury to the *Kshipra marma* may kill even earlier. The *Vishalyaghna marma* when traumatised, kill sometimes.^[15]

Importance of Trimarma

There are one hundred and seven *Marmas* located in the trunk and limbs of the body. Affliction of any one of these produces excruciating pain because of the specific association of consciousness in these parts. Amongst these *Marmas*, the one located in the trunk are more important than the ones located in the limbs because these limbs are dependent upon the trunk. Amongst the *Marmas* in the trunk, the ones located in the *Hrudaya*, *Basti* and *Sira* are the most important because these organs constitute the very basic substratum of the body.^[16]

DISCUSSION**Shadanga sharira (Concept of regional anatomy)**

Acharya Charaka, *Sushruta* and *Vagbhatta* all the three *Acharya* divided the whole body into six regions.

There are various ways by which the study of anatomy can be done. For study purpose, anatomy can be divided into two following subtypes-macroscopic or gross anatomy and microscopic anatomy. Regional anatomy is one of the important branches of macroscopic anatomy.

Similar to *Ayurveda*, according to the modern science the regional anatomy considers the organization of the body as major parts or segments: a main body consisting of the head, neck and trunk (subdivided into thorax, abdomen, back and pelvis/perineum) and paired upper limbs and lower limbs.^[17]

Regional anatomy is the method of studying the body's structure by focusing on a specific part, area or region; examining the arrangement and relationships of the various systemic structures (muscles, nerves, arteries) within it; and then usually continuing to study adjacent regions in an ordered sequence. Regional anatomy also recognizes the body's organization by layers: skin, subcutaneous tissue and deep fascia covering the deeper structures like muscles, skeleton and cavities which contain viscera.

In this way we can say that the concept of regional anatomy was known that time also.

***Asthi sharira* (Concept of Osteology)**

Charaka had not given detailed description of *Asthi* (bone). He only mentioned the total numbers of *Asthi* in human body but *Sushruta* had explained in detail. He considered the *Asthi* as the framework of body which helps in maintaining proper posture, shape and skilled movements. *Acharya Sushruta* also described that *Asthi* is the solid parts of the body.

The modern science states that the bone is composed of two types of substances-organic and inorganic. The organic connective tissue makes it tough and flexible while inorganic calcium salts makes it hard and rigid. The bones provide surface for the attachment of muscles, tendons, ligaments. These serve as levers for muscular actions. Bones form the main supporting framework of the body and are primarily designed for a more effective production of movements by attached muscles.

Acharya Sushruta has given precise description so we can say that he was very well acquainted about the *Asthi*.

Asthi sankhya

Sushruta classified the bones on the basis of their structure or shape as- flat bones, small cubical bones, cartilages, curved bones and tubular bones. Classification of this accuracy shows he was a keen observer. Enumeration i.e. *Sankhya* of human parts is as important as the knowledge of particular organ as stated by *Acharya Charaka*. According to *Chakrapani*- the knowledge of enumerate the *Avayava* of human body is important in clinical practice.

According to modern anatomy, there are about 206 bones in the adult human skeleton. The early Indian anatomist, on the other hand, count either 360 (*Atreya*) or 300 (*Sushruta*) bones. This vast difference is principally due to the facts that (besides including the teeth, nails and cartilages) they counted prominent parts of bones, such

are now known as 'processes' or 'protuberances'. This difference may be due to the basis of counting bones in modern and ancient science. Modern science includes only that structures as bones which contains Haversian system while in ancient times the basis may be the hardness of the body part and they also counted that structures which decay very late after death.

Types of *Asthi*

As *Sharira rachana* described in *Samhita* is not the pure anatomy but it is actually physiological anatomy. So, each and every aspect described has more meaning and importance than as idle and straight forward in modern anatomy. The concept of *Asthi prakaras* is also one of them. Here if we see typically types of *Asthi* are not described just for anatomical or gross study but they are aptly described on basis of clinician worth.

By using *Tarka* and *Pramana* we can understand that the particular five types defined are just symbol for major division. In fact these merely are not just types but these are basically five ways of divisions of bones on different basis as discussed below.

1. On the basis of hardness or ossification (*Tarunasthi*) - This division is on type of constituency or hardness in particularly.
2. On basis of surface area (*Kapalasthi*) - This is based on surface area of bone. *Kapala* as described is flat or which has more area than thickness. This type of *Asthi* covers or encloses the certain part or area of body.
3. On basis of specific shape (*Valayakara*) - It is ring like or round bone. Here this is described in context of ribs. These types of bones are for providing support as well as helping in inspiration and expiration i.e. providing elasticity. These also function as protector for enclosed vital organs.
4. On basis of length and end points (*Nalakasthi*) - Here *Asthi* has more length than breadth. Bones described here have head or broad end but narrow mid body i.e. shaft. Main functions of these are origin and insertion of muscles, whose movements like flexion, adduction etc help in performing different movements. Thus, these bones can be called as functional in locomotion.
5. Next division is really interesting type as sense organ (*Rucakasthi*) - *Acharya Sushruta* have divided next variety especially on power of teeth as *Rucaka*, i.e. one which can sense or know the taste of food during chewing process.
Sandhi Sharira (Concept of syndesmolgy)

In *Ayurveda*, *sandhi* is classified into two types- *Chala* (movable) and *Achala* (immovable). These movable joints further may be divided into two subtypes-
(1) *Alpa chala* (slightly movable) - like *Pratara, samudga sandhi*.
(2) *Bahu chala* (Freely movable) - like *Kora, ulukhala sandhi*. This classification resemble similar to modern classification of joints which is following:^[18]

1. Synarthrosis –an immovable joint.
2. Amphiarthrosis – a slightly movable joint.
3. Disarthrosis – a freely movable joint.

Description of *Peshi* (Myology)

In *Ayurveda*, *peshi* are classified or named on the basis of their size, shape, action and the feeling of touch like thick or thin, big or minute, short or long are on the basis of size; stout/thick or round/circular are on the basis of their structure; fix/stable or movable are on the basis of their movement; hard or soft, smooth or rough are on the basis of perception of touch.

In modern science the nomenclature of muscles is also based on same features. These are following:^[19]

1. **Shape:** Deltoid (triangular)
 - a) Quadratus (quadrangular)-quadratus femoris
 - b) Rhomboid (diamond shaped)-rhomboid major
 - c) Rectus (straight)-rectus abdominis.
2. **Size:** Major (big)-pectoralis major
 - a) Minor (small)-pectoralis minor
 - b) Longus (long)-adductor longus
 - c) Brevis (small)-palmaris brevis.
3. **Structure:** Half tendon, half muscle-semi-tendinosus
4. **Action or movement:** Extensor, flexor, abductor, adductor
5. **Position:** Anterior (front)-tibialis anterior, Posterior (back)-tibialis posterior
 - a) Supra (above)-supraspinatus,
 - b) Infra (below)-infraspinatus
6. **Depth:** Superficialis (superficial)-flexor digitorum superficialis
 - a) Profundus (deep)-flexor digitorum profundus
 - b) Externus (external)-external oblique
 - c) Internus- internal oblique

In this way we can say that the basic concept for study and classification of myology was given by the seers of *Ayurveda*.

Description of *Snayu* (ligament)

The description of ligament is mentioned in classics as *Snayu*. *Sushruta* knew that all the joints of body are bounded by ligaments. They give strength to joints. He also said that if any injury happens to *Snayu*, it causes more disability than the injuries of bones, muscles etc.

Ligaments are fibrous bands which connect the adjacent bones, forming integral parts of the joints. Ligaments are important agents in maintaining the stability at the joint. If any injury happens to ligaments, there will be pain often sudden and severe, a loud pop or snap during injury, swelling, a feeling of looseness in the joint and inability to put weight on the point without pain.

As with other soft tissue injuries, ligament healing consists of inflammation followed by repair and then remodelling. The inflammatory phase follows trauma to collagen fibres and lasts for 3-5 days, depending on the severity of the injury. The repair phase is mediated by

blood clotting over the damaged tissue for 3-21 days after the injury. The remodelling phase follows the repair phase and can last for up to a year. Because the remodelling phase lasts for up to a year, there is a potential weakness in the ligament and a risk of re-injury.

So here we can say that *Sushruta* was well known about the structure of *Snayu* and its injury.

Pramana Sharira (Concept of Anthropometry)

Significance of *Angula pramana* in *Ayurveda*

1. *Pramana sharira* can be described as the knowledge related to the body in context of life- span, measurement of parts and sub-parts of the body.
2. The body has been described (in terms of measurement) with own fingers. The entire body is 84 *Angula* in vertical length and if vertical height of the body is equal to the horizontal length in position when arms are abducted up to 90 degrees, then it is in *Sama pramana*.
3. The persons having normal measurement of the body are endowed with longevity, strength, immunity, happiness, supremacy, wealth and other qualities. Those having body with less or more measurement have qualities contrary to these.
4. The expert physician succeeds in his work if he proceeds after examining the life-span particularly on the basis of measurement of parts and sub-parts of body.

References of *Angula* in *Samhitas*: Role in various field of *Ayurveda*

1. For describing the anatomy and location of structures in the body with respect to one another.
2. For describing the length of body organs especially in context of *Marma*.
3. For describing surgical incisions sites, *Siravedha* sites and dimensions of surgical instruments.
4. For describing the features of medicinal or herbal plants.
5. For describing the *Panchakarma* procedure and instruments.
6. For describing ingredients in *Bhaishajya kalpana*.

Anthropometry is the measurements of human body which provides scientific methods and techniques for taking various measurements and observations. The word 'Anthropos' means human and 'Metry' means measurement. It is the science that defines physical measures of a person's size, form and functional capacities. It is the systematic collection and correlation of measurements of the human body.

Anthropometric measurements are used as a proxy measure for many purposes for the assessment of health status, physique, obesity, growth and development, nutritional status, economic development, human evolution, estimating skeletal frame size, sports and physical strength. The measurements of different body

parts which include the segmental lengths, bodily breadth, circumferences of trunks and limbs, skin and subcutaneous tissue fold thickness is used for designing instruments and equipments for human use.

It deals with various measurements related to the human body such as pelvimetry, craniometry, osteometry, skin fold thickness, height and weight measurements etc. Instruments used for measurements - Stadiometer, Anthropometer Rod, Head Height Needle, Spreading Calliper, Skinfold calliper, Palatometer, Goniometer, Tape, Croniophore, Mandibulometer.

All this description of *Pramana* shows that the concept of *Pramana* was basically developed very early in the era of *Ayurveda*. In *Ayurveda*, the concept of *Pramana* is used widely in different branches like *Panchakarma*, *dravya guna*, *bhaishajya kalpana*, *sharira rachana* etc. in different ways. The modern science developed the concept of *Pramana* in the form of new branch which is called anthropometry. The difference is that in *Ayurveda* the measurements were taken with help of *Swa-angula*. There was no development of instruments to take measurement but the modern science has developed so many instruments like vernier calliper, anthropometer rod and craniophore.

Concept of Marma (Vital points)

In ancient time the war was a common situation of the people and the kings, clinicians and surgeons were especially engaged with the associations of the army of the kings, as being the custodians of the health of the warriors. Injuries inflicting because of the use of the various types of weapons in the battle field i.e. sword, arrow, *Gada* etc. were belonging to the cut, puncture or blunt injuries involving various types of the structures in the body like arteries, muscles, nerves, bones and the visceral organs in general and when in combination specifying *Marma*.

Marma are the meeting points of five structures. *Ayurveda* described various superficially and deeply situated sites of human body such as; *Sira*, *asthi*, *mamsa*, *snayu*, *sandhi* which are called vital points of body. These special sites make various points which are termed as *Marma* (vital points). *Sushruta* has referred 107 anatomical points as *Marmas* in human body. If any injury or damage happens to these vital points due to any reasons, it may be very harmful. That may cause death or any deformity in the body. He presented all the *Marmas* particularly on the basis of injury results.

Acharya Charaka has mentioned importance of *Trimarma* (*Hrudaya*, *basti* and *nabhi*). It shows that he knew that these are important and delicate viscera of body and if any injury happens to these organs that will definitely lead to trivial diseases and deformity or even death. Therefore knowledge of these *Marma* is very essential for physicians and surgeons.

In day to day life, the knowledge of *Marma* is seen in the sports like cricket ex. wearing abdomen guards, thigh pads, leg pads, hand gloves, helmets etc to protect the vital points like *Janu*, *indrabasti*, *gulpha* etc. So like these the ages old *Marma vijnana* can be utilized and accepted as applied Anatomy.

In Chinese medicine the science of accupressure, art of Kungfu is the outcome of our old art of *Marma* (vital points) and its therapy respectively. *Kalari payattu* (martial arts) is also practiced in Kerala which is equivalent to the *Marma vijnana* (science of vital points).

Similarly acupuncture is found in the Chinese medicine, the art of puncturing the vital points with the fine needles to treat the specific disease.

CONCLUSION

After such explicit discussion, it can be concluded as follows:

1. The concept of regional anatomy was given as *Shadanga sharira* in *Ayurveda*.
2. Classification of bones based on shape, size and texture was given firstly in *Samhita*.
3. The basis of classification and nomenclature of muscles in modern science is similar to the *Ayurvedic* description of *Peshi*.
4. The elaborated description of *Pramana sharira* in the ancient literature show well established concept of anthropometry in past era.

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